Hungarian Central Statistical Office

SEASONAL ADJUSTMENT
METHODS
AND
PRACTICES

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[1] The new title was proposed by Eurostat.

CONTENTS

1 Introduction

Statistics represent nowadays a key tool for economic policy-making, business cycle analysis and modelling, and forecasting. However, short-term statistics are often characterised by seasonal fluctuations and other calendar/trading-day effects, which can mask relevant short and long-term movements of the series, and hinder a clear understanding of economic phenomena, like trend, turning points and consistency between other indicators. The main aim of seasonal adjustment is to remove changes that are due to seasonal or calendar influences to produce a clearer picture of the underlying behaviour.

Seasonal adjustment is a routine activity in statistical offices nowadays, and the number of series to be adjusted is rapidly increasing. Indeed, seasonal adjustment is a subject of perpetual debate in many respects, with many seasonal adjustment methods and tools still under development. Because of the great flexibility concerning adjustment settings and model selection the results are often considered fairly subjective. The seasonally adjusted data depend also on properties related to the person performing the procedure. However, methods provide statistical diagnostics tests for validation.

The implementation of a seasonal adjustment procedure has many important features. First of all, it is very time consuming, needs significant computer and human resources, and has several theoretical frameworks.

During the last few decades the importance of official quality has become increasingly evident. In 1999, Statistics Sweden proposed the formation of a Leadership Expert Group (LEG) on Quality to attain improved quality in the European Statistical System (ESS). The main purpose of the proposal was to provide a number of recommendations for the ESS regarding its quality work.

The LEG follow-up and quality methodology grant was an international development project aimed at improving quality in the European Statistical System. The main aim of the project was to compile a handbook recommending good practices, which should be based on the review of the state-of-the-art, analysis of the applied current practices, and identification of possible benchmarks and models to be recommended.

The call is based on two LEG on Quality recommendations and one Code of Practice (CoP) principle[2].

No. 10: NSIs should develop Current Best Methods (CBMs) for their most common processes. A handbook for developing CBMs covering construction, dissemination, implementation and revision of CBMs should be developed. Existing and relevant CBMs should be collected and distributed in the ESS.

No. 11: A set of recommended practices for statistics production should be developed. The work should start by developing recommended practices for a few areas followed by a feasibility test in the ESS.

CoP Principle 7: Sound methodology must underpin quality statistics. This requires adequate tools, procedures and expertise.

This document aims at facilitating the improvement of the quality of the seasonally adjusted data production process regarding the statistical offices of the European Statistical System.

The intention was to synthesize the applied seasonal adjustment practices and methods and to publish a complete description for all statistical offices in the ESS which contains also recommended practices and a proposal for quality report on seasonal adjustment.

[2] The European Statistics Code of Practice (CoP) is a minimum European standard for the institutional set-up of statistical authorities which was developed by a task force set up by the Statistical Programme Committee. It contains 15 principles.

In spring of 2006 a questionnaire was sent to the statistical offices in the European Statistical System in order to collect information about the current practices, which give the basis for the synthesized recommendations. The summary of the results can be found in Chapter 4, while a detailed description on the webpage of the Hungarian Central Statistical Office (www.ksh.hu/hosa).

The users of this document can have different level of knowledge of seasonal adjustment, therefore it is recommended for all users and statisticians who want to deal with seasonal adjustment, and understand the concepts of seasonal adjustment. This document contains the main issues concerning the seasonal adjustment, aims at giving a guide on how to perform seasonal adjustment process and includes a lot of references to achieve advanced information.

In Chapter 2 a short historical summary of seasonal adjustment methods from the beginning to date is given. In the subsequent chapter, some basic definitions are included to help deeper understanding of the main concepts. In Chapter 4, the survey on practices in the European Statistical System is outlined. Chapter 5 reviews the most widely used seasonal adjustment methods and software within the ESS. Finally, Chapters 6 and 7 deal with the recommended practices and a proposal for quality report on seasonal adjustment.

Annex I contains the questionnaire of the survey. Annex II includes data tables which are stemming from the survey. In Annex III a state of the art is given about the procedure applied during seasonal adjustment at some NSIs. In Annex IV a detailed description of the SA methods and software is given. In Annex V, the current Eurostat recommendations are outlined. Annex VI contains the description of the proposed quality indicators and finally in Annex VII a proposal for quality report is given.

For exchange practices and information relating to seasonal adjustment in the European Statistical System the interest group of Eurostat can be used.

The authors would like to thank Sandra Jung and Dominique Ladiray for the description of BV4.1 and Dainties; Statistics Sweden, especially Sven Öhlén for the very interesting studies and the colleagues for the descriptions of their practices. Special thanks for all comments, suggestions and corrections and for the very useful discussion with the participants of the workshop held in Budapest, especially for the sincere assistance of Cristina Calizzani and Gian Luigi Mazzi on behalf of Eurostat.

2 Brief Historical Background

The analysis of the components of time series has a long history going back to work in astronomy, meteorology, and economics in the 17th through 19th centuries, and to early seasonal analysis by Buys-Ballot (1847). The early work concentrated on first removing the spurious correlation between two variables. Poynting (1884) and Hooker (1901) attempted to remove the trend and seasonal differential from prices by averaging prices over several years. Spencer (1904) and Andersen (1914) introduced the concept of higher order polynomials in eliminating the trend component.

There was a flurry of activity in the area of seasonal adjustment during the 1920s and 1930s due to the work of Persons (1919), who came up with a method to isolate the four unobserved components in a time series as

$$X_t = S_t \times T_t \times C_t \times R_t \text{ (assuming a multiplicative relationship)}$$

where S_t is the seasonal component; T_t is the trend component; C_t is the cyclical component; R_t is the random component. His method used fixed seasonal factors although it was well noted in the literature at the time that in certain domains the idea of fixed seasonality was not valid. It was up to Crum (1925) to modify Person's original method in order to handle varying seasonality.

The first overall seasonal adjustment methodology was created by Macauly (1930). This approach is nowadays commonly referred to as "Classical Decomposition" and laid the foundations of many modern-day approaches including the X11-ARIMA method.

Two major developments came during the early 1950s. The first one was the introduction of exponential smoothing techniques which simplified the tedious computations previously needed. The second development was the introduction of computers, which also provided an impetus to decomposition methods since calculations that previously took days could be performed in a few seconds. This allowed researchers to develop even more complicated methods since each new version could be easily tested on large number of time series in order to test its quality.

The **Census I method** was introduced in 1954. This goes beyond Macauley's method by forecast beyond the current series and backcast before the beginning of the series in order to replace the missing data which results at the beginning and end of the series. The Census I was the initial version which was later modified to produce Census II (1955) by Shiskin, which was basically an electronic version of manual methods which had previously been used.

The **Census II method** was criticised on several points. The critical reviews led to more sophisticated variants of Census II resulting in the **X-11** variant in 1965, which was the most widely used seasonal adjustment practice until the 1980s. The X-11 version had one important development namely trading day adjustments by using sophisticated regression techniques. The approach taken in X-11 is the culmination of the work of Eisenpress (1956), Marris (1960) and Young (1965). X-11 also allowed the user to choose between additive or multiplicative seasonality, and to define the type of moving average used.

Following the work of Box and Jenkins in the 1970s on autoregressive moving averages a new semi-parametric variant of X-11 was developed by Dagum (1980) of Statistics Canada. **X-11-ARIMA** differs from its predecessors by using ARIMA model to forecast beyond the current series and backcast before the beginning of the series. The result was that revisions were significantly reduced when finally the missing data became available. The newer versions (X-11-ARIMA/88 and X11-ARIMA/2000) mainly extend the methodology by diagnostic messages. These are semi-parametric models.

The **X-12-ARIMA (1997)** program had been introduced at the mid 1990s. It placed the analysis of trading days, the treatment of holidays and outliers effects, and the replacement of the missing data to new basics, and also widened the range of diagnostics, like revision history and sliding spans.

Beside the **moving average methods**, pure **model based** approaches were also developed. By these parametric models, we have to make distinction between deterministic and stochastic models.

The **Deterministic methods** consider the trend and seasonality as predetermined behaviour curve, and the uncertainty only affects as diverting the time series' real value from that curve. The deterministic models are based on regression analysis, which handles trend and seasonality with some deterministically defined methods. Examples for deterministic models are **DAINTIES** and the **BV4**.

The **Stochastic methods** ascribe significant effect to uncertainty, and it has an important role in modelling. Two main groups of global stochastic models can be distinguished: ARIMA model and Structural Model.

By **ARIMA** (**A**uto **R**egressive **I**ntegrated **M**oving **A**verage) model based approach, one starts by modelling the time series and derives the models for the components from this estimated model. In the **structural model** based approach, one starts directly with the estimation of the components (Engle (1978), Harvey and Todd (1983)). The most received structural models are **BAYSEA** (Akaike and Ishiguro (1980)), **DECOMP** (Kitagawa (1985)) and **STAMP** (Koopman, Harvey, Doornik and Shepherd (1995)), the latter uses the Kalman filter and related algorithms to fit unobserved component time series models.

The modelling of time series can be traced back at least to Yule (1927) who introduced autoregressive models and Slutsky (1937) who proposed moving average models. It was up to Wold (1938) to fit such moving average models to data and he also described the use of mixed ARMA models (1954). Box and Jenkins' (1970) findings provided a set of criteria to determine the type of and order of an ARIMA model, which should be applied, to any time series. In addition these rules were based on statistical theory thereby satisfying one of the main criticisms levelled against the ad-hoc approaches.

ARIMA modelling used non-seasonal and seasonal differencing in order to model non-stationary series. The first practical realization of this modelling took place in the Bank of England in the 1980s. Further developments were made at the Bank of Spain under the control of Augustin Maravall, and resulted in the **TRAMO/SEATS** program (Gómez and Maravall (1997)).

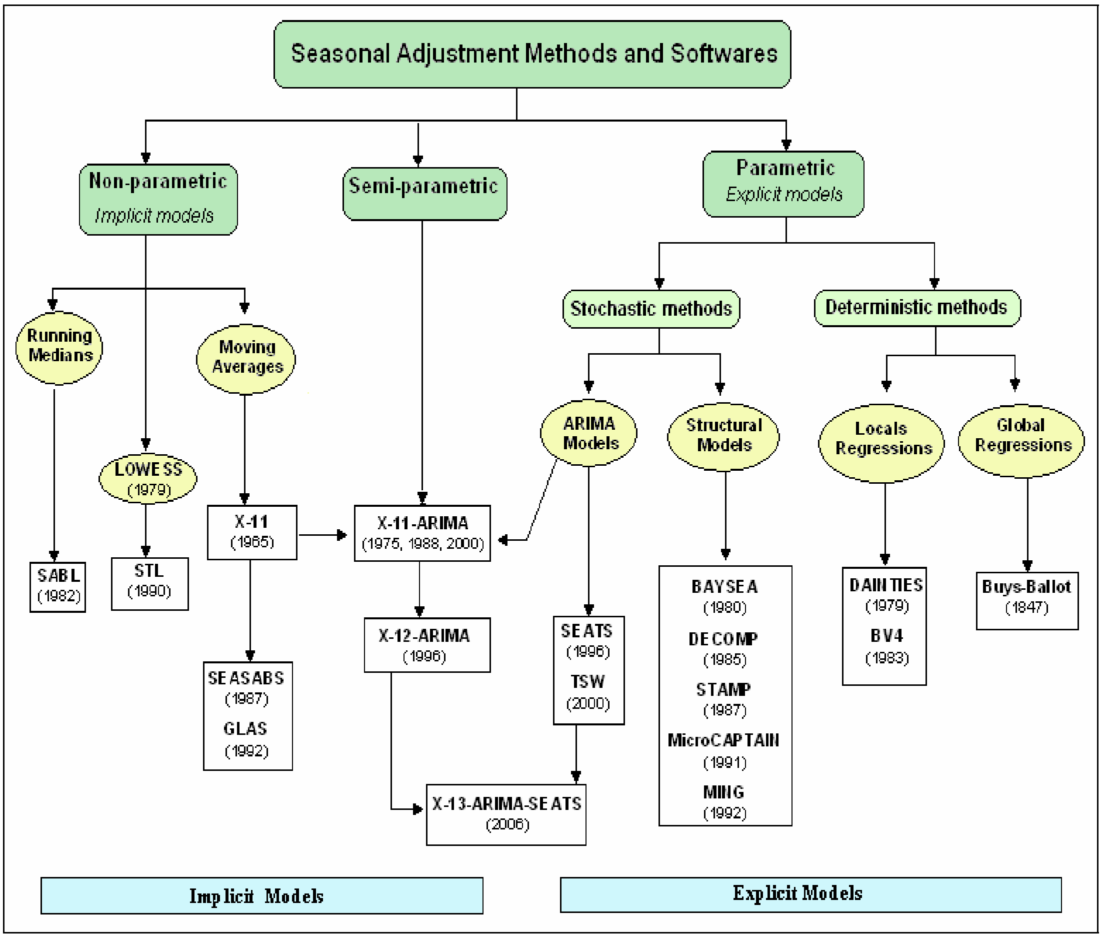
The **X-13-ARIMA-SEATS** (2006) seasonal adjustment program is an enhanced version of the X-11 Variant of the Census Method II seasonal adjustment program. The enhancements include a more self-explanatory and versatile user interface and a variety of new diagnostics to help the user detect and remedy any inadequacies in the seasonal and calendar effect adjustments obtained under the program options selected. Along with the automatic modelling procedure introduced in X-11-ARIMA, X-13-ARIMA-SEATS includes an additional automatic modelling procedure based on the method found in TRAMO. X-13-ARIMA-SEATS also contains the SEATS algorithm allowing users to perform regARIMA model-based seasonal adjustment. Whereas the X-11 seasonal adjustment method computes the decomposition using a family of seasonal and trend moving-average filters, the SEATS method computes the decomposition using filters determined by the estimated regARIMA model.

Research from Hood, Ashley, and Findley (2000) recommended using SEATS adjustments for some series once more if diagnostics became available. Now with X-13-ARIMA-SEATS, there are spectral, revision history, and sliding spans diagnostics that have been available for a long time for X-11 types of adjustments.

Besides parametric models, other non-parametric models were developed too, for example the **SABL** (**S**easonal **A**djustment at **B**ell **L**aboratories), see Cleveland, Devlin and Terpenning (1982). It is a method which is in principal similar construction to X-11. SABL was especially created to handle anomalous data (outliers). It can handle data with all frequencies (for example monthly and quarterly) and the length of the smoothing function is controllable by the users.

The development of the methods is best described by the following flowchart, as presented by Dominique Ladiray.

Figure 1: Flowchart of the development of methods from Dominique Ladiray



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3 Basic Definitions

3.1 Types of Time Series Analysis

A **time series** is a collection of the values of some quantitative characteristic observed at regular intervals of time. These observations may be primary data or indices produced from them. The time series can be classified into two different groups. The **stock** series show the output of some activity measured at different points of time, while the **flow** series reflect the measured activity over a given period. Mostly the flow series contains calendar effects (see *3.6*) but both types of series can be adjusted using the same seasonal adjustment process.

The nature of the hypothesis (on the series or the components) leads to different time series analysis methods. In the case of **non-parametric methods** (for example moving averages) the components do not depend on parameters. When examining time series with **parametric methods**, one should distinguish deterministic and stochastic analysis. The deterministic model is based on the assumption that time series follow a predetermined course permanent in the long run. In this case the series can be modelled with simple mathematical functions (e.g. linear trend). These models accept the presence of a random factor, but they try to eliminate this effect.

In contrast to this, the stochastic analysis regards the random variable as a fundamental part of the process; it examines the short-term effects and uses random variables for the modelling of the process.

3.2 Components and Linkage Options of the Time Series

The time series can be decomposed into **four main unobserved components:**

Trend (*T*) indicates the long-term tendency, represents the structural variations of low frequency in a time series.

Cyclical component (*C*) indicates the medium term fluctuation. The cyclical component is worth examining only in case of very long time series. In accordance with the general practice, the trend component is assumed to include also the cyclical component. Sometimes the trend and cyclical components together are called as trend-cycle.

Seasonal component (*S*) is that part of the variations in a time series which represents intra-year fluctuations more or less stable year after year with respect to timing, direction and magnitude. It is also referred to as the seasonality of a time series. It reflects normal variations that recur every year to the same extent, e.g. weather fluctuations that are representative of the season, length of months, Christmas effect, etc. It may also include calendar related systematic effects that are not regular in their annual timing and are caused by variations in the calendar from year to year.

Irregular component (*I*) includes unpredictable effects, which are considered as random variables; it is assumed that the expected value of these factors is 0 (for an additive model) or 1 (for a multiplicative model). The irregular component of a time series is the residual time series (remaining component) after the trend, the cyclical and the seasonal components (including calendar effects) have been removed.

Sometimes **calendar effects** (Trading day effect **(*TD*)** and Easter effect **(*E*)**) or the **outliers (*O*)** are additional separate components.

Figure 2: Types of time series[3]

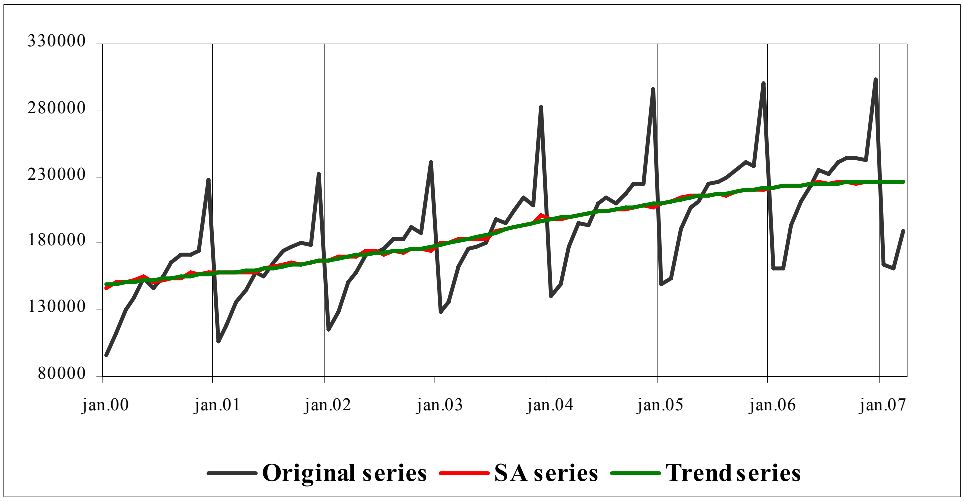
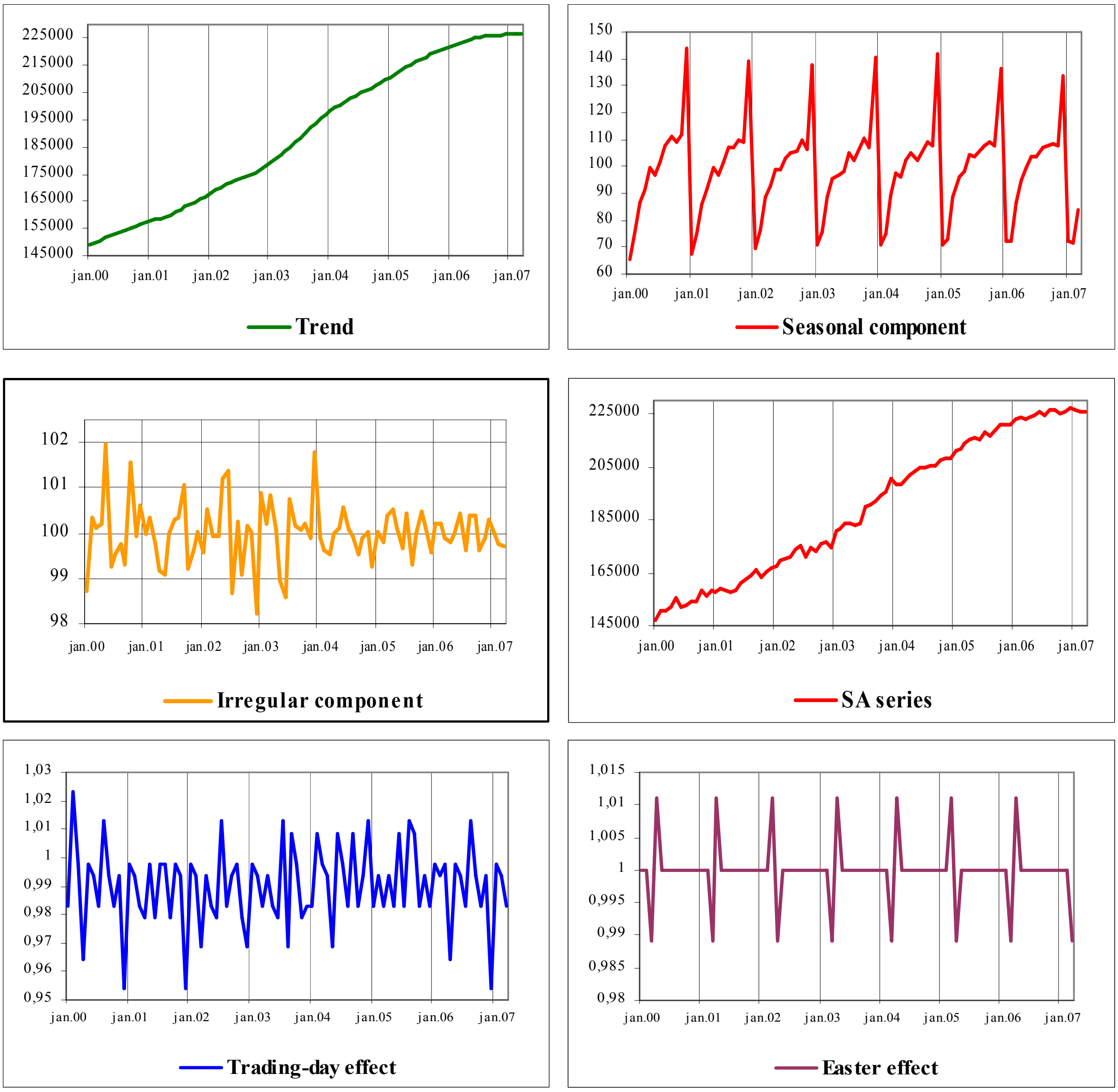


Figure 3: Components of a time series[4]



[3] Source: Hungarian Retail Sale of Non Food Product from January 2000 to March 2007.
[4] Source: Hungarian Retail Sale of Non Food Product from January 2000 to March 2007.

The previous mentioned components may be mutually linked in several ways. The most frequently specified models are the additive and the multiplicative model.

Additive model is used when the components are linked additively:

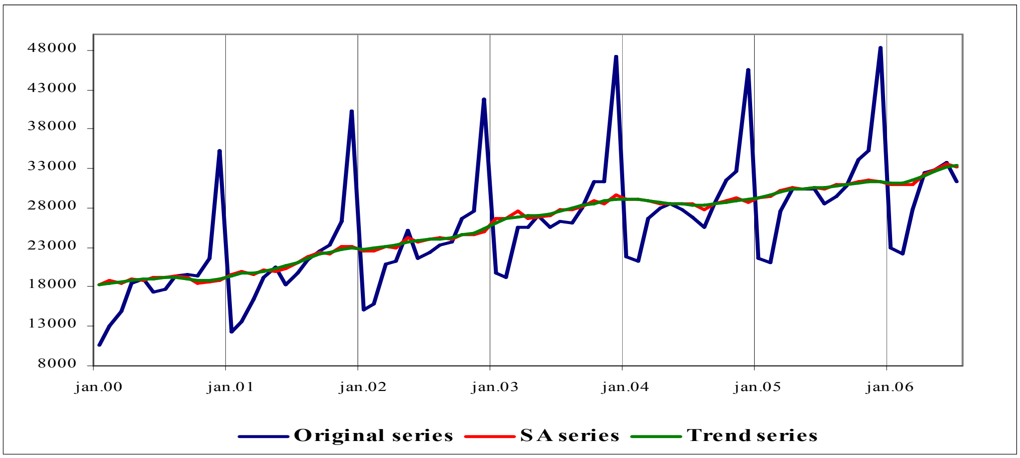
$$Y = T + C + S + I,$$

or with separate calendar and outlier effects:

$$Y = T + C + S + O + TD + E + I.$$

This model is based on the assumption that the difference of the trend and the observed data is nearly constant in similar periods of time (months, quarters) irrespectively of the tendency of the trend, i.e. the measure of seasonal deviation is largely concurrent. In this case the four components of the time series are independent of one another.

Figure 4: An additive model[5]



Multiplicative model is used when the components are linked through multiplication:

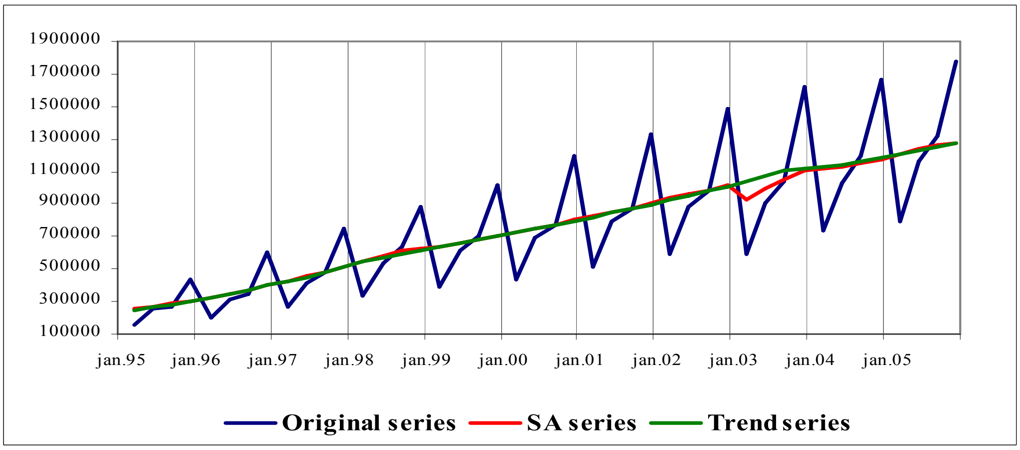
$$Y = T \bullet C \bullet S \bullet I,$$

or with separate calendar and outlier effects:

$$Y = T \bullet C \bullet S \bullet O \bullet TD \bullet E \bullet I.$$

In this model the "magnitudes" of the seasonality increase (decrease) with an increasing (decaying) trend.

Figure 5: A multiplicative model[6]



[5] Source: Hungarian Retail Sale of Textiles Clothing from January 2000 to July 2006.
[6] Source: Hungarian Gross Fixed Capital Formation from January 2000 to December 2005.

Log-additive model is used to specify an additive model on the logarithm of the time series. The logarithm of a time series decomposed multiplicatively may be specified as the sum of logarithms of the components. In this manner the multiplicative model can be traced back to the case of the log-additive model, therefore these latter two model types are frequently considered identical.

Pseudo-additive model type was developed at the National Statistics UK (ONS). It is applied when decomposition is fundamentally multiplicative yet the time series may have values equal or close to zero:

$$Y = T \cdot C \cdot (S + I - 1).$$

or with separate calendar and outlier effects:

$$Y = T \cdot C \cdot O \cdot TD \cdot E \cdot (S + I - 1).$$

This model type is supported exclusively by the methods of seasonal adjustment belonging to the family X; TRAMO/SEATS does not support this model type.

The separate calculation of cyclical component is not discussed in the following; the trend component also includes the cyclical component.

3.3 The Seasonal Component

In the deterministic analysis of time series the effect of seasonality is considered constant, that is, the magnitude of the seasonality in similar periods of time is supposed to be identical along the entire length of the time series. The condition of constant seasonality, however, is not fulfilled in the stochastic analysis; in this case the methods in use take into account the so-called moving seasonality as well. This method has the advantage to avoid the under- and overcorrection which might be induced by a fixed seasonal pattern.

From the viewpoint of calculating the seasonal component, the selection between the additive and multiplicative decompositions is mostly a decisive factor in performing the analysis of the time series. Even if not always, yet in a number of cases the time series indicates clearly which decomposition model describes the behaviour of the time series better.

3.4 Seasonally Adjusted Time Series

The **seasonally adjusted time series (SA)** is calculated with the help of the above mentioned components. In this case the initial time series is adjusted for seasonal variations, including calendar effects if present, that is, either the value of the seasonal effect related to the given time period (month, quarter) is deducted from the initial time series (SA=Y–S) or the initial time series values are divided by the seasonal component (SA=Y/S). Consequently the time series obtained includes the trend and random components.

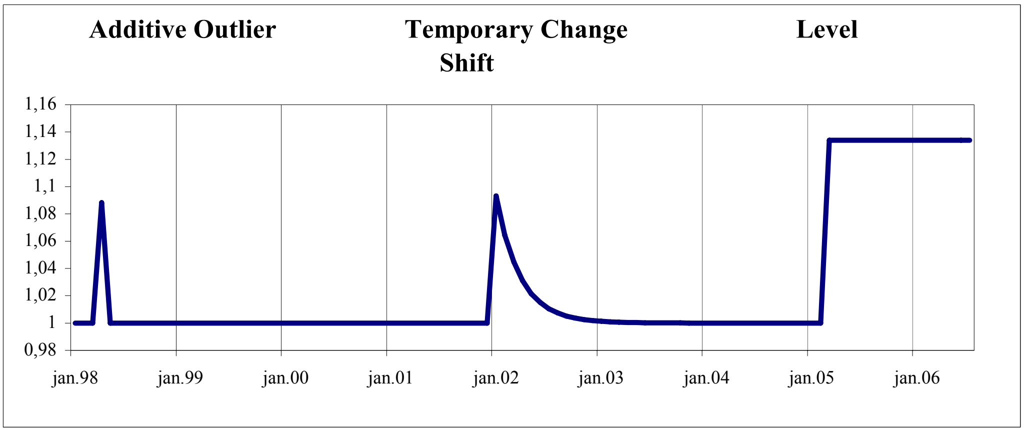
If neither seasonal nor calendar influences are present in the original data, the seasonally adjusted series is given by the original data. For series with no identifiable seasonal variations, but with identifiable calendar variations, the seasonally adjusted series is given by the calendar adjusted series.

3.5 The Outliers

Outliers are data which do not fit in the tendency of the time series observed, which fall outside the range expected on the basis of the typical pattern of the trend and seasonal components. Typically a one-off economic or social event is in the background of the values identified as outliers, the effect of which causes the time series data to diverge from the earlier tendency for a shorter or longer period of time. Regarding industrial production, such events may include for example the closing of a dominant manufactory in the industry causing a drop in output, since any further data indicate only the output of the remaining companies. The enactment of a new law or the implementation of a new form of subsidy, or the levying of a new type of tax may have a similar effect.

The most frequent types of outliers are as follows: additive outlier, temporary change, level shift, ramp outlier, innovative outlier, seasonal outlier.

Figure 6: Some types of outliers



Additive outlier (or impulsive outlier, AO): the value of only one observation is affected. Outliers may either be caused by random effects or due to an identifiable cause as a strike, bad weather or war. For example in the sector of pharmaceutical and medical goods the number of sold medicines increase dramatically before a high price rising.

Temporary change (TC): the value of one observation is extremely high or low, then the size of the deviation reduces gradually (exponentially) in the course of the subsequent observations until the time series returns to the initial level. The TC can be regarded as a sequence of additive outliers as well. For example in the construction sector the production would be higher if in a winter the weather was better than usually (i.e. higher temperature, without snow). When the weather is regular, the production returns to the normal level.

Level shift (LS): starting from a given time period, the value of all observations compared to the earlier values "hang out" to a similar extent, that is, the level of the time series undergoes a permanent change. There are many potential causes of level shifts in a series, including change in concepts and definitions of the survey population, in the collection method, in the economic behaviour, in the legislation or in the social traditions. For example when the salaries of the teachers increase from September the level of time series will be higher in the whole educational sector. Some of these causes may also lead to a seasonal break.

As a general rule, additive outliers and temporary changes are added to the irregular component, and level shifts to the trend.

Ramp outlier allows for a linear increase (or decrease) in the level of the series over a specified time interval. (The X12-ARIMA provides this type of outlier for example.)

Innovative outlier (IO): represents a shock in the innovations of the model, affects not only the level of the observations at the time the outlier occurs but also the subsequent observations. This effect depends on the specified ARIMA model for the series.

Seasonal outlier: there is an abrupt change in the seasonal pattern and the level of the series is altered over the remaining periods. This effect is similar to the Seasonal Level Shift (SLS) outlier which is discussed in Kaiser and Maravall (2001). The X13-ARIMA-SEATS contains this outlier.

3.6 Calendar Effects

The calendar effects component is that part of the time series which represents calendar variations, such as trading/working days[7], moving holidays and other calendar-related systematic effects that are not regular in annual timing and are caused by variations in the calendar from year to year. One part of the calendar effects (e.g. the lengths of months) is seasonal, which belongs to the seasonal component. For this reason the calendar component should contain only the nonseasonal part of the calendar effects.

A time series may be affected by the number of **trading day**s in the time period (for example in a month). The problem follows from the fact that the number of trading days may differ not only from period to period, but it may also vary among the same time periods in different years, which will impact upon the level of activity in that month or quarter for flow series or the sort / type of day for stock series, therefore trading day effects can not be managed as ordinary seasonal effects. The **leap-year** effect can influence the time series too, because it means an additional day in every four year, and it can fall on trading day or weekends.

The number of trading days is also affected by the number of **holidays** in the given time period that do not fall on weekends. Since the national holidays vary from nation to nation, in each case the national holidays prevailing in the given country need to be considered. Some countries also include bridging effects in working day adjustments. These result in taking holidays from people, for example, on Mondays and Fridays when an official public holiday occurs on Tuesdays and Thursdays, respectively.

The number of working or trading days in a given month or quarter can vary significantly for each statistical domain (e.g. production, merchandise trade) because of different institutional arrangements, trade specific holidays, etc. In some cases the number of trading days does not affect the observed values, for example when plants produce in a non-stop manner.

Some religious holidays (e.g. Easter, Ramadan) constitute the **moving holidays** which occur each year, but where the exact timing shifts. For example there may be a need for managing the Easter effect on certain time series (for example in the case of retail trade), because Easter may be either in March or in April, and it may also affect the one-week time period preceding Easter. This type of effect is adjusted by a generated regression variable.

If only the effect of the trading days and Easter is filtered out from the time series observed and seasonality remains, the resulting one is a **trading day adjusted series**.

3.7 Direct and Indirect Seasonal Adjustment

If a time series is a sum (or other composite) of component series, one can sum the seasonally adjusted component series to get a seasonally adjusted aggregate series. This is called the **indirect adjustment** of the aggregate series. Usually the same approaches and software are used to adjust the components. Whereas in some cases (e.g. to calculate the European aggregates or when enough information is unavailable about the seasonal adjustment approach) it is unavoidable to calculate the aggregate series based on differently adjusted components. This is called **mixed indirect adjustment**. Reviewers can also calculate a **direct adjustment** of the aggregate series by summing the components first and then seasonally adjusting the total.

An indirect adjustment is usually appropriate if the component series have very different seasonal patterns. However, if the component series of an aggregate are adjusted on the basis of different models and identified outliers, the aggregate of the seasonally adjusted figures of the components may not be expected to agree with the seasonally adjusted figures of the aggregate series. This is also true for the balance or ratio of related time series. Only under very specific circumstances is it mathematically guaranteed that the sum (or difference) of seasonally adjusted components is equal to the aggregate (or

[7] In this document trading day (TD) and working day (WD) are used as synonyms. In some cases trading day and working day are distinguished. Trading day effect can be modelled with 7 regressors, while working day with 2 regressors.

balance) adjusted seasonally directly. This will happen if an additive adjustment is used with the same filters in each case, and no outliers are detected. However, most of the economic time series encountered in practice behave in a multiplicative way, extraordinary and untypical effects (like strikes) occur and the determinants of the seasonal pattern are different from time series to time series, which requires different seasonal filters in the adjustment process.

3.8 Trend Types in the Analytical Trend Calculation

In the course of analytical trend calculation, the **linear trend function** is applied mostly to determine the basic tendency, because it fits well in a shorter time period and its interpretation is the simplest. The linear trend function assumes that the change in data is constant.

Along with the linear trend, non-linear trend functions may also prove suitable to describe the trend inherent in the time series. In this case the polynomial trend and its special case, the parabolic trend as well as the **exponential trend** play an important role, assuming that the growth rate in the basic data is given by a simple rule.

3.9 Moving Average Trend

A moving average is a method for smoothing time series by averaging (with or without weights) a fixed number of consecutive terms. The averaging "moves" over time, each data point of the series is sequentially included in the averaging, while the oldest data point in the span of the average is removed. In general, the longer is the span of the average, the smoother is the resulting series.

Moving averages are used to smooth fluctuations in time series or to identify time series components, such as the trend, the cycle, the seasonal, etc.

The moving average trend calculation is, in fact, a transition between a deterministic trend calculation equipped with functions and a stochastic trend calculation based on probabilities. The moving average trend values are obtained by averaging the basic data rather than by using the explicit expression of some function. At the same time and in contrast to stochastic analyses, the determination of the trend and that of the other components are not linked closely, and the components are obtained one after the other rather than concurrently.

The trend value at time t is calculated as the average of the value of the series at t and the values in a proper neighbourhood of t. By averaging the time series is "smoothed out", that is, the importance of the random term is reduced on the one hand, and by altering the value of t we try to follow the tendency, on the other hand.

When identifying the number of terms to be included in the calculation of the moving average, one should take into account the seasonality of the time series within one year. If any periodicity is revealed within one year, then the number of terms must be selected accordingly, that is, it is reasonable to select a four-term moving average for quarterly data and a twelve-term moving average for monthly data if the data follow some seasonality. Should the time series include no periodicity at all, then the number of terms may be selected at the user's discretion.

3.10 Introduction to the Stochastic Methods

The deterministic time series analysis deserves its name because the essential components of the time series are deterministic, that is, their future values can be precisely predicted on the basis of the past values. In such cases the random effect is compressed into a separate component and eliminated in the course of estimations and forecasts to the highest possible extent. This component constitutes the residuals – and also the error of estimations in the deterministic model.

Stochastic time series analysis is able to capture the characteristics of a time series, where no systematic movement is observable. The random effect is taken into account also in components, and each components is regarded as the realization of a stochastic process.

Some conventions in notation used in the following will be introduced. The backshift (or lag) operator is denoted by *B* (or *L*).In the notation of time series no distinction is made from the data generating the stochastic process: both are typically denoted by x_t or y_t.

A first-order autoregression, denoted *AR(1)*, satisfies the following difference equation*:*

$$y_t = c + \phi y_{t-1} + \varepsilon_t,$$

where *c* could be any constant and $\{\varepsilon_t\}$ is a white noise sequence*:*

$$E(\varepsilon_t) = 0 \tag{1}$$

$$E(\varepsilon_t^2) = \sigma^2, \tag{2}$$

and for which

$$E(\varepsilon_t \varepsilon_\tau) = 0 \tag{3}$$

for $t \neq \tau$.

Let $\{\varepsilon_t\}$be a white noise sequence and consider the process

$$y_t = \mu + \varepsilon_t + \theta\varepsilon_{t-1},$$

where μ and θ could be any constant. This time series called a first order moving average process, denoted *MA(1)*.

An *ARMA(p,q)* process includes both autoregressive and moving average terms:

$$y_t = c + \phi_1 y_{t-1} + \phi_2 y_{t-2} + \cdots + \phi_p y_{t-p} + \varepsilon_t + \theta_1 \varepsilon_{t-1} + \theta_2 \varepsilon_{t-2} + \cdots + \theta_q \varepsilon_{t-q},$$

or, in backshift operator form,

$$\left(1 - \phi_1 B - \phi_2 B^2 - \cdots - \phi_p B^p\right) y_t = c + \left(1 + \theta_1 B + \theta_2 B^2 + \cdots + \theta_q B^q\right) \varepsilon_t.$$

If *d* is a nonnegative integer, then $\{x_t\}$is an *ARIMA(p,d,q)* process if

$$y_t := (1 - B)^d x_t$$

is an *ARMA(p,q)* process. The first parameter (*p*) refers to the number of autoregressive lags, the second parameter (*d*) refers to the order of integration, and the third parameter (*q*) gives the number of moving average lags.

Whenever the time series examined is seasonal, the autocorrelation corresponding to seasonal lags (12 observations for monthly data) are significantly different from zero. Such time series are not modelled appropriately by ordinary ARIMA models, because a high order (12 or more) autoregressive and/or moving average model ought to be estimated for taking these autocorrelations into account. The solution is provided by the so-called seasonal autoregressive integrated moving average (seasonal ARIMA or SARIMA) model. In fact it is a special ARIMA model, where certain coefficients are equal to zero, and conditions following from the specification are satisfied for other coefficients. The generalization is that seasonal differentiation (that is, the application of the $1 - B^S$ operator) is possible. There are two types: the additive and the multiplicative SARIMA model. The additive type is beyond the scope of this paper. The general formula of the multiplicative *SARIMA* (*p*, *d*, *q*)(*P*, *D*, *Q*) model type is as follows:

$$\phi_p(B)\Phi_P(B^S)\nabla^d \nabla_s^D y_t = \theta_q(B)\Theta_Q(B^S)\varepsilon_t,$$

where

$$\phi_p(B)\Phi_P(B^S) = (1+\phi_1 B+\phi_2 B^2+...+\phi_p B^p)(1+\Phi_1 B^S+\Phi_2 B^{2S}+...+\Phi_P B^{PS})$$

denotes the autoregressive polynomial in *B*,

$$\theta_q(B)\Theta_Q(B^S) = (1+\theta_1 B+\theta_2 B^2+...+\theta_q B^q)(1+\Theta_1 B^S+\Theta_2 B^{2S}+...+\Theta_Q B^{QS})$$

denotes the moving average polynomial in *B*,

$$\nabla^d \nabla_s^D = (1-B)^d (1-B^s)^D$$

is the differencing operator and ε_t is white noise sequence satisfying (1), (2) and (3).

The decomposition procedure of the SEATS method is built on spectrum decomposition; therefore the fundamentals of spectrum analysis (or frequency domain analysis) are summarized below.

The Fourier-analysis is an old-established method for the examination of functions, where a periodic function is decomposed into the sum of sine and cosine functions of varying frequency and amplitude. The initial function is characterized by amplitudes corresponding to pre-specified frequencies. The resulting series is the Fourier-series, and the amplitudes are the so-called Fourier-coefficients. The procedure may be generalized for non-periodic functions and series as well.

The spectrum analysis was introduced for the examination of time series on the analogy of the Fourier-analysis. Spectrum analysis relies on the approach whereby the values of the autocovariance function of a stationary time series are specified as the Fourier-coefficients of the so-called spectral density function. The short name of the spectral density function is spectrum, which is a non-negative symmetric function on the $[-\pi, \pi]$ interval. Not all the stationary time series have a spectral density function**;** the condition of the sufficiency for its existence is that the sum of the absolute values of autocovariances should be finite. This can be hypothesized for most of the time series occurring in practice.[8]

In such cases the spectrum can simply be specified in the following manner:

$$f(\lambda) = \frac{1}{2\pi}\sum_{h=-\infty}^{\infty} e^{-ih\lambda}\gamma(h) \cdot$$

The spectrum of certain processes can be calculated easily by the help of this relationship; for example the spectrum of white noise with variance σ^2 is $\frac{\sigma^2}{2\pi}$, which is constant.

The peaks appearing in the spectrum indicate periodicity in the time series corresponding to the given frequency. The analysis of the spectrum also helps in the examination of the effect of the so-called time-invariant linear filters. For example the ARMA-process may also be interpreted as the output of a special time-invariant linear filter applied to the white noise as an input. In this case the output spectrum is the product of the spectrum of the input process and the squared gain[9] of the filter. The result of seasonal adjustment by the X family and the TRAMO/SEATS application may also be interpreted as the output of a time-invariant linear filter applied to the initial time series, therefore the spectral approach proved useful in the comparison of various methods for seasonal adjustment.

In producing the spectrum, the theoretical autocovariance function is taken as starting point; consequently this is a theoretical spectrum to be estimated on the basis of the actual realization of the time series. There are two methods available for estimation. The first is estimation by the use of the so-called periodogram (or smoothed periodogram), whereby the spectrum, in fact, is estimated with the help of the estimation of the autocovariance function. The second option is that some models, e.g. the ARMA are adapted to the time series and the spectrum of the time series is calculated with the help of the information on the model's theoretical spectrum.

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[8] This condition is not necessary for example for processes of long memory (or long range dependent processes). For such processes the autocovariance function decays slowly, therefore the absolute sum of autocovariances is infinite. Notwithstanding the aforesaid these processes also have a spectral density function.

[9] In other words the power transfer function.

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4 Summary of Seasonal Adjustment Practices in NSIs[10]

The primary objective of this chapter was to provide a brief overview on the current seasonal adjustment practices applied by statistical offices within the EU, EEA/EFTA and EU candidate countries. This chapter is based on the summary of country replies on the questionnaire designed by the Hungarian CSO (See in Annex I.). The large-scale data tables can be found in Annex II or on the following homepage: http://www.ksh.hu/hosa.

The structure of the questionnaire was built upon the OECD survey[11] in 2002, for this reason some answers are comparable.

In this chapter we summarise the important issues:

- Practices of statistical offices;
- Methods and software used;
- Updating the models and parameters during the seasonal adjustment procedure;
- Methods settings, regressors used;
- Application fields;
- Metadata and publication policy;
- Indicators and their diagnostics used to evaluate the seasonal adjustment process.

A questionnaire on seasonal adjustment was sent out to 32 countries in March 2006, with a total response rate of 97%. At least one questionnaire was answered by each NSI except Belgium. Eleven institutions delivered more than one filled-in questionnaires. The 15 old EU Member States (EU-15) were examined in addition to the 12 new Member States (NMS-12) including already Bulgaria and Romania which joined the EU in 2007. The countries (Croatia, Iceland, Norway, Switzerland and Turkey) which are not Members of the EU, will be hereinafter referred to as Non-EU countries.

Table 1: Response rate

Region	Country	Answers		Region	Country	Answers		Region	Country	Answers	
		counted	aggregated			counted	aggregated			counted	aggregated
EU-15	Austria*	2	×	EU-15	Portugal*	2	×	NMS-12	Malta	1	×
	Belgium*				Spain*	2	×		Poland*	1	×
	Denmark*	1	×		Sweden*	1	×		Romania	1	×
	Finland*	3	×		United Kingdom*	1	×		Slovak Republic*	9	×
	France*	8	×	NMS-12	Bulgaria	2	×		Slovenia	1	×
	Germany*	3	×		Cyprus	1	×	Non-EU	Croatia	3	×
	Greece	1	×		Czech Republic*	2	×		Iceland*	1	×
	Ireland*	1	×		Estonia	1	×		Norway*	1	×
	Italy*	2	×		Hungary*	1	×		Switzerland*	1	×
	Luxembourg*	1	×		Latvia	1	×		Turkey*	1	×
	Netherlands*	1	×		Lithuania	1	×	**Total**	**32**	**58**	**31**
								Answers as % of total			**97%**

*These 22 countries participated in the OECD survey.

[10] The whole evaluation can be found on homepage: http://www.ksh.hu/hosa, or accessible also via email (hosa@ksh.hu).
[11] OECD: Harmonising Seasonal Adjustment Methods in European Union and OECD Countries.

Evaluation Method and Calculation Technique

In most cases the possibility of multiple answering was given. Some institutions delivered more than one filled-in questionnaire. In such cases we merged the different questionnaires into one. This means that only one aggregated questionnaire for each country is counted in the responses. For this reason the sum of answers can be more than the sum of countries which replied. For example two different organisations in Austria – Statistics Austria and WIFO – delivered one filled-in questionnaire each. They may give different answers to a question but these answers belong to one respondent country.

The number of answering countries and their rate from the total can be found in the last column (see for example Table 2). The rates of answering countries are 97% because one country did not fill in the questionnaire. The other columns contain the number of answers. The item response rate was calculated with respect to the number of answering countries in each column.

4.1 Practices of Statistical Offices

Unified Seasonal Adjustment Methods in the Organisations[12] (Q1)

Nowadays, 80% of the institutions have unified procedures for seasonal adjustment on organisation or on department level. 35% of them have harmonised results of seasonally adjusted time series for the whole office, while others apply unified procedures only on department level.

23% of the national institutions do not use any unified seasonal adjustment method. Those who chose the "other option" cooperate with other institutes or units in the field of seasonal adjustment.

Table 2: Unified procedures in organisations

		Unified procedures in organisations				
		On organisation level	On department level	No	Other	Number (**Rate**) of answering countries
Total	Answer	11	14	7	3	31 (**97%**)
	%	**35%**	**45%**	**23%**	**10%**	

Seasonal Adjustment Expert Group[13] (Q2)

42% of the questioned countries have a seasonal adjustment expert group, while 39% do not have one. Those who answered other (23%) usually do not have an expert group because either one person is responsible for the seasonal adjustment in the methodology unit or the subject matter departments are responsible for their series independently of one other. There is an expert group in every second EU country.

4.2 Methods Used

Seasonal Adjustments Methods Used[14] (Q4)

Nowadays, 81% of the respondent NSIs use some version of TRAMO/SEATS as a seasonal adjustment method. X12-ARIMA takes more than half (52%) the share of the total market, while the use of X11-ARIMA takes 19% share of the total market. TRAMO/SEATS is used in 13 countries as a stand-alone method.

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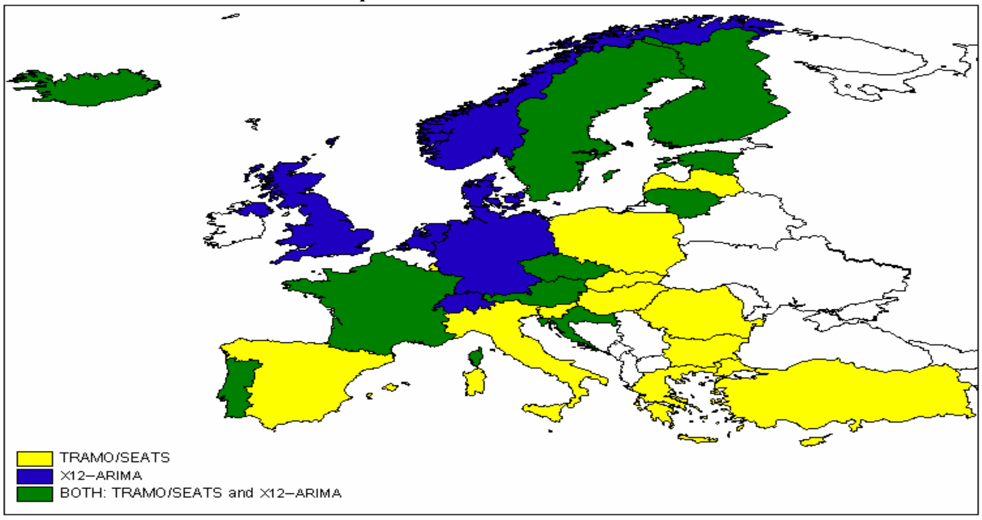
[12] See in Annex I.
[13] The response rate was 97%.
[14] The response rate was 97%.

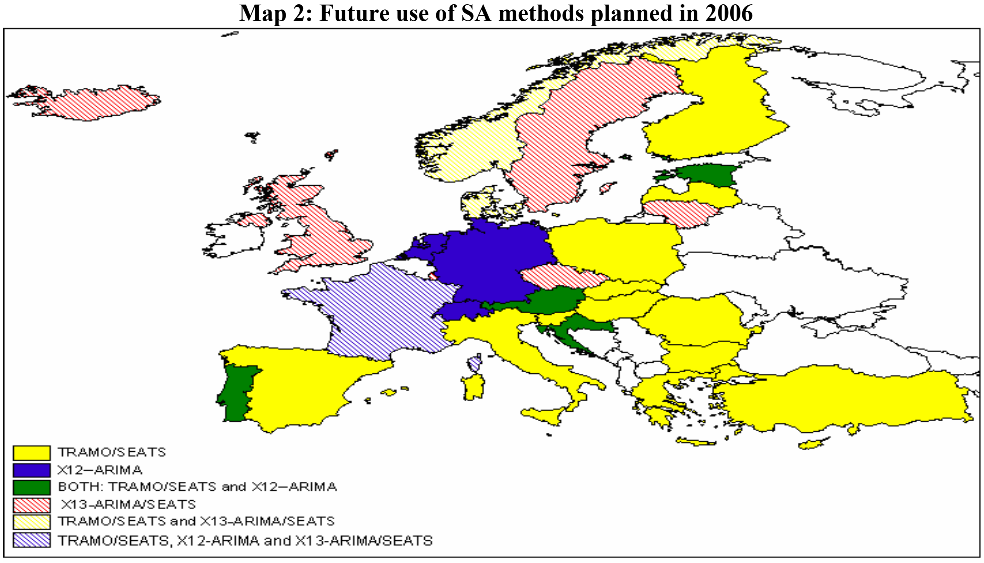
In EU countries about 80% of the institutions use TRAMO/SEATS as a seasonal adjustment method. 55% of them use it as a stand-alone method and about 41% use it in combination with X12-ARIMA. 100% of the 12 new EU Member States countries have chosen TRAMO/SEATS and 8 of them as a stand-alone method. Other methods take 6% of the market and include methods such as BV4.1 by the Statistical Office in Germany and Dainties by the Statistical Office in the Czech Republic.

Map 1: SA methods used in 2006



In accordance with countries' plans the use of X12-ARIMA could decrease dramatically (26% of the answering countries envisage to use it) over the next few years, as soon as X13-ARIMA/SEATS appears. 29% of the countries plan to apply X13-ARIMA/SEATS. 68% of the countries use TRAMO/SEATS in the future.

Map 2: Future use of SA methods planned in 2006



This section aims at showing how many changes there were in the last 4 years in the field of SA methods. The OECD survey (2002) was compared to the HoSA survey (2006). Since the coverage of the surveys was not the same, those countries were examined which answered both questionnaires. Only 16 countries met this criterion.

Table 3: SA methods used in 2002 and 2006[15]

		Seasonal Adjustment Methods				Number (Rate) of answering countries
		TRAMO/SEATS	X11	X12	Other	
Methods used in 2002	Answer	5	9	6	3	16 **(73%)**
	%	**31%**	**56%**	**44%**	**19%**	
Methods used in 2006	Answer	10	4	10	2	16 **(73%)**
	%	**63%**	**25%**	**63%**	**13%**	
Methods planned in 2002	Answer	8	0	10	4	16 **(73%)**
	%	**50%**	**0%**	**63%**	**25%**	

During the last 4 years big changes could be seen in the use of seasonal adjustment methods. The use of TRAMO/SEATS increased the most. In 2006 the rate of the use of the X12-ARIMA method was 63% among the countries which participate in both surveys, while in 2002 it was only 44%. The use of X11method declined dramatically in the period examined.

In case the plans in 2002 are compared to the current situation, one can see that most of the countries changed their methods according to their plans.

Software Used (Q7)

Nowadays, about 71% of the investigated institutions use Demetra software because it includes both X12-ARIMA and TRAMO/SEATS methods. More than one quarter of the NSIs apply either version of X12-ARIMA and another similar proportion of them TRAMO/SEATS. More than 80% of Demetra users apply version 2.04, while version numbers are varying in the case of TRAMO/SEATS and X12-ARIMA. Seven countries have internally developed (BV4.1 in Germany) or other software (SAS with X11 procedure).

In EU countries the second software is any version of TRAMO/SEATS, while in non-EU countries it is X12-ARIMA. Among non-EU countries no one uses in-house developed or other software.

Table 4: SA software used in 2006

		Software used				
		Demetra	TRAMO/SEATS	X12-ARIMA	Other	Number **(Rate)** of answering countries
Total	Answer	22	9	8	7	31 **(97%)**
	%	**71%**	**29%**	**26%**	**23%**	

The following table shows the cross-distribution of the methods and software.

Table 5: Methods and Software used (Number of answers)

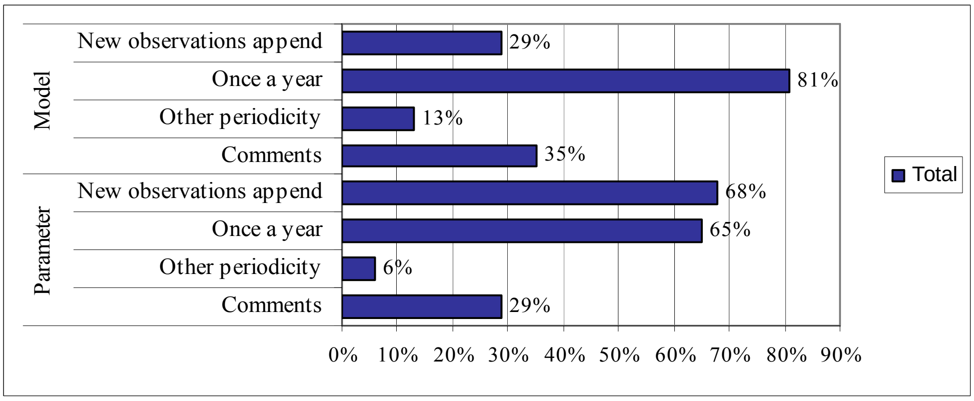
Software		Methods					Total No. of answers
Name	Version	TRAMO/SEATS	X12-ARIMA	X11-ARIMA	BV4	Dainties	
Demetra	2	4	1	-	-	-	**4**
	2.0x	18	10	-	-	-	**18**
TRAMO/SEATS	1.04 or previous	4	-	-	-	-	**4**
	2.04	2	-	-	-	-	**2**
	unknown	3	-	-	-	-	**3**
X12-ARIMA	0.x	-	3	-	-	-	**3**
	2.10	-	5	-	-	-	**5**
X11(-ARIMA)		-	-	3	-	-	**3**
SAS		-	-	3	-	-	**3**
BV4		-	-	-	1	-	**1**
Dainties		-	-	-	-	1	**1**
Total No. of answers		**24**	**16**	**6**	**1**	**1**	

[15] See the large-scale data tables in Annex II.

Updating Models and Parameters During the SA Procedure[16] (Q10)

In this section the current situation is presented first, followed by the comparison with the OECD survey.

Figure 7: Updating of the SA procedure



Updating models

The revision of seasonal adjustment models was carried out by all respondent countries on a fixed periodicity. Most of them perform updating once a year (81%); a few make updates every five years, while only two countries update options more frequently (6 months). About a third of the institutions also update models when new observations become available mainly in case of important key series. Those who answered other they update the model more frequently if a specific problem arises or they do not have methodological policy.

When comparing the surveys, one can see that most of the countries revise and update a seasonal adjustment model once a year, but the ratio is much bigger in 2006 than in 2002. The ratio of other periodicity increased, while the share of new observations decreased.

Table 6: Frequency of the model updating in 2002 and in 2006[17]

Survey in		Update model			Number (**Rate**) of answering countries
		New observations appended	Once a year	Other periodicity (in month)	
2002	Answer	3	7	3	13 (**59%**)
	%	**23%**	**54%**	**23%**	
2006	Answer	2	11	4	13 (**59%**)
	%	**15%**	**85%**	**31%**	

Updating parameters

The revision of parameters is performed on a fixed periodicity by 71% of the investigated countries. 68% of them update the parameters when new observations are appended.

When comparing the surveys, it can be seen that updating parameters once a year and new observations appended doubled. Other periodicity was completely eliminated.

Table 7: Frequency of the parameter updating in 2002 and in 2006[18]

Survey in		Update parameters			Number (**Rate**) of answering countries
		New observations appended	Once a year	Other periodicity (in month)	
2002	Answer	5	4	4	13 (**59%**)
	%	**38%**	**31%**	**31%**	
2006	Answer	10	8	0	13 (**59%**)
	%	**77%**	**62%**	**0%**	

[16] The response rate was 97%

[17] See the large-scale data tables in Annex II.

[18] See the large-scale data tables in Annex II.

Aggregating Methods (Q11)

The direct adjustment is predominant and used by 94% of the respondent countries, while indirect adjustment is used by 74% of them. 21 countries apply direct adjustment for more than 50% of the series, while the other 7 countries use mostly the indirect one.

Only 2 countries use the indirect adjustment alone, while the use of direct adjustment only is observed in 8 countries. There are several countries where different aggregating methods are used on department level. In certain cases the direct, in other the indirect adjustment is dominant. These countries are: the Czech Republic, France, Germany, Italy, Portugal and Spain.

Table 8: Aggregating methods

		Aggregating methods						
		Direct / Indirect						
		100% / 0%	75-100% / 0-25%	50-75% / 25-50%	50% / 50%	25-50% / 50-75%	0% / 100%	Number (**Rate**) of answering countries
Total	Answer	8	8	5	3	5	2	31 (**97%**)
	%	**26%**	**26%**	**16%**	**10%**	**16%**	**6%**	

Outliers Handling (Q15, Q16)

Concerning the types of outliers the main practice, used by over 75% of the investigated countries, is the use of AO, TC, LS. The remaining countries usually use two of the three types of outliers. Additive outlier is used in all responding EU countries, while level shift is used in all non-EU countries.

The types of outliers are detected "in most cases by test" in 61% of the countries, while half of the countries use test every time. It is rare that expert-defined outliers are used, and there is no country where experts alone make the decision.

Some NSIs indicated that they used a mixture of methods, e.g. France detects the outliers by experts and by test too. Germany uses a mathematical identification procedure for additive outliers (including tests) and expert definition for level shifts. The outliers are defined in the Netherlands automatically and/or by experts, while in the UK consultations are held with data experts to decide whether an outlier is due to an economic event.

Table 9: Outliers handling

		Types of Outliers						Types of detecting outliers				
		Additive outlier	Temporary change	Level shift	Number (**Rate**) of answering countries			Always by test	In most cases by test	In most cases experts define	Only experts define	Number (**Rate**) of answering countries
Total	Answer	30	26	28	31 (**97%**)		Answer	16	19	3	0	31 (**97%**)
	%	**97%**	**84%**	**90%**			%	**52%**	**61%**	**10%**	**0%**	

Validation of the Process (Q17)

Experts validate the results during the seasonal adjustment process in 86% of the countries. In more than 75% of the NSIs outliers and regressors are validated. The type of transformation is validated only in half of the investigated countries. Four countries did not report any validating.

There are four countries which validate other information during the seasonal adjustment process: Finland: model, the correlation in the residuals, the revision; France: the presence of seasonality;

Lithuania: the model and significance of the parameters; the Netherlands: the seasonal adjustment and filters used.

Table 10: Validation of the process

		Validating of the process					
		Outliers	Type of transformation	Regressors	Result	None	Number (**Rate**) of answering countries
Total	Answer	22	15	23	25	2	29 (**91%**)
	%	**76%**	**52%**	**79%**	**86%**	**7%**	

Field of Application of SA (Q18)

Almost all countries publish the seasonally adjusted time series, while over 50% of countries use them to make forecasts in addition. Less than 30% of the countries use SA-data for validation and even less for imputation.

One in four EU countries uses the process for imputation. About a third of the institutions use the process for validation, while among non-EU countries one country only.

Table 11: Application of SA

		Application of SA				
		For publication	For imputation	For validation	For forecasts	Number (**Rate**) of answering countries
Total	Answer	30	6	9	17	31 (**97%**)
	%	**97%**	**19%**	**29%**	**55%**	

Publication Policy and Metainformation (Q19, Q20)

In this section the current situation is presented first, followed by the comparison with the OECD survey.

At least two types of data are published by almost all countries. All types of data (raw, seasonally adjusted, trend and working day adjusted data) are published in 13 respondent countries, but it is familiar that three data types are published.

All countries publish raw data; 97% of them publish also seasonally adjusted data. 77% of the respondent countries publish working day adjusted data. Trend is published to the least extent, but it means that more than half of the countries publish it. Germany publishes also residual components.

88% of EU countries publish working day adjusted data and 58% of them trend data, while only one non-EU country does so.

Table 12: Publication policy

		Publication policy				
		Raw data	SA data	Trend	Working day adjusted data	Number (**Rate**) of answering countries
Total	Answer	31	30	16	24	31 (**97%**)
	%	**100%**	**97%**	**52%**	**77%**	

<u>Seasonal adjustment method</u>

Method used as metadata is published by 96% of the responding countries in several of the different databases offered. 92% of the countries make available information in this category for internal use and for external use, while 69% publish such information to Eurostat.

Parameters used in the SA process

Information on the parameters used is published by 67% of the respondent countries. 89% of them make available this information for internal use. However, half of the answering countries store metadata in this category in a single type of database. A major difference between EU and Non-EU country is that 6 of EU countries bring out this type of information for external use and 8 of the EU countries bring out this type of information for Eurostat, while none of the non-EU countries uses this support.

Italy publishes it only for industrial production indices.

Working/trading day adjustment applied

Metadata related to the applied working/trading day adjustment is published by 78% of the respondent countries and all of them provide this information for internal use. Almost an identical of them make this type of metadata available for external use and for Eurostat (13 and 14 countries respectively).

Outlier information

Documentation about events explaining outliers is published by about one third of the responding countries. However, all of them make available this information for internal use.

All of the responding EU countries bring out information on outliers, while none of the non-EU countries publish these.

Other metadata

Other types of metadata are published by only about 11% of the responding countries. ISTAT stated that regARIMA models were stored only for industrial production indices. The United Kingdom reported that the publication of quality measures was being considered. Croatia gave some methodological notes in its publications.

Table 13: Publication of metainformation

Region		Publication of metainformation															
		Method(s) used				Parameters used in the SA				Working/trading day adjustment applied				Documentation about events explaining outliers			
		For internal use	For external use	For Eurostat	Number of answering countries	For internal use	For external use	For Eurostat	Number of answering countries	For internal use	For external use	For Eurostat	Number of answering countries	For internal use	For external use	For Eurostat	Number of answering countries
Total	Answer	24	24	19	**26**	16	6	8	**18**	21	13	14	**21**	8	3	3	**8**
	%	**92%**	**92%**	**69%**	**96%**	**89%**	**33%**	**44%**	**67%**	**100%**	**62%**	**67%**	**78%**	**100%**	**38%**	**38%**	**30%**

To compare the OECD survey with HoSA survey, in 2002 the half of the respondent countries published the used method for external use, while in 2006 all of them published. There is a similar tendency regarding the parameters. While in 2002 only one country published the parameter for external use, five countries (from the 9 respondent countries) did so in 2006. The tendency is the same concerning the working day adjustment. More countries published this information for external use in 2006 compared to 2002. All answering countries published all the predetermined types of metainformation for internal use. Regarding documentation about outliers the results could not be compared by reason of low response rates.

Table 14: Publication of metainformation in 2002 an 2006[19]

Survey in		Publication of metainformation								
		Method(s) used			**Parameters used in the SA**			**Working/trading day adjustment applied**		
		For internal use	For external use	Number (**Rate**) of answering countries	For internal use	For external use	Number (**Rate**) of answering countries	For internal use	For external use	Number (**Rate**) of answering countries
2002	Answer	14	7	14 (**64%**)	9	1	9 (**41%**)	10	4	10 (**45%**)
	%	**100%**	**50%**		**100%**	**11%**		**100%**	**40%**	
2006	Answer	14	14	14 (**64%**)	9	4	9 (**41%**)	10	5	10 (**45%**)
	%	**100%**	**100%**		**100%**	**44%**		**100%**	**50%**	

Type of Publications (Q21)

All countries have paper or Internet publications of their data. A large part of the institutions (71%) has reference databases. The information is published by 39% of the countries in ad hoc user's queries and by 23% of them on CD-ROM-s.

Table 15: Type of publications

Region		Type of publications					
		Paper publications	Internet publications	CD-ROMs	Reference databases	Ad hoc users' queries	Number (**Rate**) of answering countries
Total	Answer	30	29	7	22	12	31 (**97%**)
	%	**97%**	**94%**	**23%**	**71%**	**39%**	

[19] See the large-scale data tables in Annex II.

4.3 Quality Aspects of the SA Process

Quality measures for adjustment were evaluated by the institutions using a scale from 0 to 5, where 0 meant ‘not used’ and 1 to 5 graded answers went from ‘not relevant’ to ‘very significant’. The highest average score among the pre-printed alternatives was graphical inspection which indicated a score of 4.2. The second most important feature with a score of 3.9 was statistics on residuals. This can be mainly explained by the fact that at least one of the predetermined alternatives is built in the software features. The stability over time as an indicator has an average relevance. The other two indicators, autocorrelation function and fit statistics are on the same level with a score of about 2.8. The open alternative “other indicators” was marked by only eight countries of the EU. This topic was given the best score with an average value of 4.7.

Graphical Inspection as a Quality Indicator (Q23/a)

The most relevant indicator is the graphical inspection. The half of the institutions use as indicator the mean and standard deviation of the raw and SA series. Close to 67% of the responding institutions indicated the face of fit as an indicator of graphical inspection. It is an alternative indicator of quality because cannot be defined a unified measurement for it. The standard deviation relative to trend was indicated by over 40% of the institutions. This value is more significant in non-EU countries. The MCD/QCD statistics indicated the lowest rate (13%) among EU and non-EU countries, too.

Some countries denoted other indicators with specification in terms of graphical inspection. Germany uses raw and final seasonal factor as indicator, Italy the month to month variations on SA series especially in the last two/three years and the spectral peaks at seasonal and working day frequencies. In Netherlands expert judgement, while in Switzerland the spectral peaks are taken into consideration. In Sweden the graphical inspection is used to the SA and Trend-series and their changes arise on a yearly level, for residuals and eventually for spectrum for residuals.

Table 16: Graphical inspection as a quality indicator

Region		**Graphical inspection as a quality indicator**					
		Relevance	Mean and standard deviation of the raw and SA series	Standard deviation relative to trend	MCD/QCD statistics	Intuitively on face of fit	Number **(Rate)** of answering countries
Total	Answer	4.2	15	13	4	21	30 (**94%**)
	%		**50%**	**43%**	**13%**	**70%**	

Statistics on Residuals as Quality Indicators (Q23/c)

This is the second most relevant indicator with a score of 3.9. The Ljung-Box Q-statistics was indicated by 90% of the institutions. The second most used statistics is the normality test, over 80% of the respondents indicated this option. The other three statistics are also relevant; about 70% of the institutions use these alternatives.

There is a difference between Q-statistics and Q-statistics for squared residuals. In both cases Q-statistics have higher relevance than Q-statistics for squared residuals.

The open alternative “other indicators” was indicated by three countries. From these, Italy uses three indicators like statistical significance of the mean, standard deviation and Studentized residuals. Sweden indicated five further indicators: significance of the ARIMA model, standard deviation of changes of the SA series, BIC, sign test on residuals and DW-test on residuals.

Table 17: Statistics on residuals as quality indicators

Region		Statistics on residuals as quality indicators						
		Relevance	Ljung-Box Q-statistics	Ljung-Box Q-statistics for squared residuals	Box-Pierce Q-statistics	Box-Pierce Q-statistics for squared residuals	Normality test	Number (**Rate**) of answering countries
Total	Answer	3.9	27	22	23	19	25	30 (**94%**)
	%		**90%**	**73%**	**77%**	**63%**	**83%**	

Stability Over Time as Quality Indicator (Q23/e)

For those institutions which use stability analysis, this option has average significance.

87% of the countries use stability analysis over time. About the half of them apply this analysis in special cases which are the following: if required by subject matter statistician or users; when changing model or the regressor values; in specific studies; for the most important time series; for annual revision or for large outliers.

Only 6 countries do not use stability analysis: 5 from the EU and 1 from the non-EU countries, respectively.

Table 18: Stability over time as a quality indicator

Region		Stability over time as a quality indicator				
		Relevance	Every time	In special case	Never	Number (**Rate**) of answering countries
Total	Answer	3.3	12	17	6	30 (**94%**)
	%		**40%**	**57%**	**20%**	

Autocorrelation Function as a Quality Indicator (Q23/b)

The relevance of this indicator is not really dominant. Over 60% of the institutions consider the significant peaks of the autocorrelation function. The other two pre-printed alternatives: Box-Pierce statistics on residuals and F-test for seasonality have the same rate, close to 50%. Only three countries use other indicators than the pre-determined options, namely France, the Slovak Republic and Germany. The latter uses the ACF and PACF of the model residuals.

Table 19: Type of publications

Region		Autocorrelation function as a quality indicator				
		Relevance	The significant peaks of the autocorrelogram	Box-Pierce statistics for seasonality	F-test for seasonality	Number (**Rate**) of answering countries
Total	Answer	2.7	19	14	14	30 (**94%**)
	%		**63%**	**47%**	**47%**	

Fit Statistics as Quality Indicator (Q23/d)

Only about half of the respondents use from the fit statistics indicators the Akaike Information Criteria (AIC). The same proportion of institutions use the Bayesian Information Criteria (BIC). The third option AICC was indicated only by 20% of the respondent institutions.

An additional option was indicated by three countries, but none of them was specified.

Table 20: Fit statistics as a quality indicator

Region		Fit statistics as a quality indicator				
		Relevance	AIC	AICC	BIC	Number **(Rate)** of answering countries
Total	Answer	2.9	14	6	14	30 (**94%**)
	%		**47%**	**20%**	**47%**	

Other Alternatives for Quality Indicators

Eight countries use other indicators than the pre-named ones to evaluate the results.

Sweden indicated the most (six) alternatives: spectral analysis of residuals, variability of the SA series, tests of parameters of the ARIMA-models, consistent estimates of TD/WD effects, graphical inspection of the residuals and the changes of the SA series and the estimated outliers. *Austria* takes into consideration beside the spectral analysis of outlier adjusted original series, the SA series and irregulars too. *Italy* considers the similarity of quarterly rates (with respect to the corresponding quarter to the previous year) of raw and SA series. *Germany* indicated the tests on stable seasonality, *the Netherlands* the quality test and both take notice of t-values of the regressors. *Poland* remarks the percentage of outliers and the *Slovak Republic* the growth rates. *The United Kingdom* uses descriptive statistics, too.

Quality Measures for the Results (Q24)

The significance of the use of any kind of composite quality indicator is relatively low. Those who use X12-ARIMA take into consideration M and Q-statistics. In case of TRAMO/SEATS there is a difference: 60% of the organisations indicated the SA quality index. Sweden has some explorative quality measures under tests. (See in Annex VI.)

The United Kingdom has developed some measures of quality that are currently reviewed in relation to the publication of metadata. Italy indicates mean, variance and MAPE of revisions in SA data as quality measures. In Germany this quality measure is not relevant because of the series- and user-independent character of the BV4.1 approach.

Table 21: Quality measures for the results

Region		Quality measures for the results				
		M-Statistics	SA quality index	No	Other	Number **(Rate)** of answering countries
Total	Answer	15	18	9	4	30 (**94%**)
	%	**50%**	**60%**	**30%**	**13%**	

5 Methods and Software

In this chapter a short summary is given about the currently used seasonal adjustment methods and software in the ESS. A detailed description can be found in Annex IV, and full documentation about X12-ARIMA on www.census.gov/srd/www/x12a/ , about TRAMO and SEATS on www.bde.es , and about BV4.1 on http://www.destatis.de/mv/e/methueb.htm .

5.1 *TRAMO and SEATS*

TRAMO (**T**ime Series **R**egression with **A**RIMA Noise, **M**issing Observations and **O**utliers) and SEATS (**S**ignal **E**xtraction in **A**RIMA **T**ime **S**eries) are linked programs originally developed by Victor Gómez and Agustin Maravall at Bank of Spain.

The two programs are structured to be used together, both for in-depth analysis of a few series or for routine applications to a large number of them, and can be run in an entirely automatic manner. When used for seasonal adjustment, TRAMO preadjusts the series to be adjusted by SEATS. The two programs are intensively used at present by data-producing and economic agencies, including Eurostat and the European Central Bank.

Programs TRAMO and SEATS provide a fully model-based method for forecasting and signal extraction in univariate time series. Due to the model-based features, it becomes a powerful tool for a detailed analysis of series.

TRAMO is a program for estimation, forecasting and interpolation of regression models with missing observations and ARIMA errors, in the presence of possibly several types of outliers.

The basic methodology is described in Gómez and Maravall (1992, 1994, 1996, 2001) and Gómez, Maravall and Peña (1999).

SEATS is a program for decomposing a time series into its unobserved (trend-cycle, seasonal, transitory and irregular) components (i.e. for extracting the different signals from a time series), following an ARIMA-model-based method. The method was developed from the work of Cleveland and Tiao (1976); Box, Hillmer and Tiao (1978), Burman (1980), Hillmer and Tiao (1982), Bell and Hillmer (1984); Maravall and Pierce (1987) and Maravall (1988) in the context of seasonal adjustment of economic time series. In fact, the starting point of SEATS was a preliminary program built by Burman for seasonal adjustment at the Bank of England (1982 version).

Versions of the TRAMO and SEATS Programs

Several versions of the programs are made available at the Bank of Spain (www.bde.es).

The *DOS versions* are widely used and particularly helpful when many series are jointly treated.

Program *TSW* (a Windows version) is the most widely used at present. Notably, the capacity to treat many series at once (metafiles) has bean considerably expanded and provides a much richer output.

FAMEST is an interface of TRAMO/SEATS with FAME under Windows.

TSMATLAB is an interface that permits to run TRAMO and SEATS when MATLAB is provided.

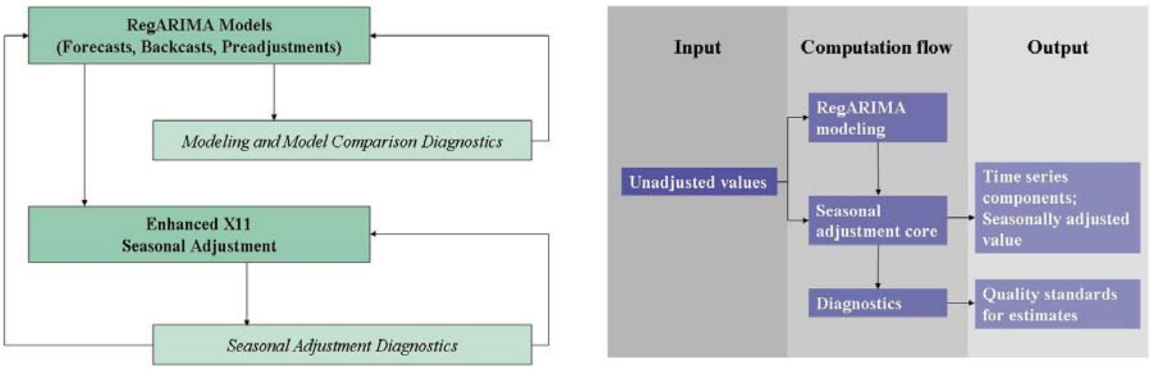
LINUXST is a Linux version of TRAMO/SEATS.

5.2 *X12-ARIMA*

X12-ARIMA was developed by US Census Bureau as an extended and improved version of the X11-ARIMA method of Statistics Canada (Dagum (1980)). The program runs through the following steps. First the series is modified by any user-defined prior adjustments. Then the program fits a regARIMA model to the series in order to detect and adjust for outliers and other distorting effects for improving forecasts and seasonal adjustment. The program then uses a series of moving averages to decompose a time series into three components. In the last step a wider range of diagnostic statistics are produced, describing the final seasonal adjustment, and giving pointers to possible improvements which could be made.

The X12-ARIMA method is best described by the following flowchart, as presented by David Findley and by Deutsche Bundesbank respectively.

Figure 8-9: Flowcharts of the X12-ARIMA



Versions of the X12-ARIMA Programs

On the U.S. Census Bureau website (http://www.census.gov/srd/www/x12a/) there are accessible PC and Unix versions of the software.

In addition, a SAS/Graph program (X12-Graph) is available that allows users to generate useful diagnostics from X12-ARIMA output.

Other software or interfaces, where you can find X12-ARIMA and TRAMO/SEATS:

Table 22: Software and methods

Software	X12-ARIMA	TRAMO/SEATS
Confort		×
Demetra	×	×
EVIEWS	×	×
GAUSS	×	
GRETL	×	×
Mathematica		×
Modeleasy+		×
OxMetrics	×	
R	×	×
SAS	×	×

5.3 The BV4.1 Procedure

In Germany, the decomposition and the seasonal adjustment of economic time series by the “Berlin Procedure” (BV) have a long tradition. The mathematical core – a moving (local) regression model approach – was developed in the late sixties at the Berlin Technical University and the German Institute for Economic Research (DIW) (Nullau, Heiler et al. (1969)). Shortly after (1972), the Federal Statistical Office (Destatis) established the first practicable version of the procedure to provide the general public with information on trends and seasonally adjusted data of major business-cycle indicators. From 1983 the BV4 version of the procedure was used, a version aimed at a largely standardization of the procedure (Nourney, M. (1983), (1984)). The standardization was done by fixing the linear regression models of the approach. The choice of the models was based on frequency domain characteristics (gain function, phase delay function) of the connected linear filters to estimate the (unobservable) trend-cycle component and to seasonally adjust the series.

In the course of 2004, BV4 was replaced by the new version BV4.1 (Speth, H.-Th. (2004)) with methodological improvements concerning the estimation of outliers and calendar effects. In addition, the user can now specify explanatory variables, which are to be considered in the course of the analysis.

Program *BV4.1* (a Windows version) is a widely used software in Germany.

5.4 DAINTIES

DAINTIES, was developed in the late 1970s (Fischer (1995); Hendyplan (1997); Hylleberg (1986)), as a successor of the SEABIRD method for the official seasonal adjustment method of the European Commission. It is based on the basic decomposition model to trend, seasonal and irregular components but only provides the user with the seasonally adjusted series (and, implicitly, the seasonality). The method is based on moving regression methods and makes the hypothesis that the series and/or its components cannot be modelled in a simple way across the complete span.

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6 Recommended Practices for Seasonal Adjustment

6.1 General Recommendations

This chapter synthesizes the Eurostat (2007) – under development -, ECB (2000, 2003), OECD (2006), Statistics Canada (2003) and U. S. Census Bureau (2006) guidelines to ensure the quality of seasonal adjustment.

Several elements and choices influence seasonal adjustment methods. These degrees of freedom lead to different results when applying seasonal adjustment methods. The importance of seasonally adjusted and trend-cycle series, the influence of the pre-adjustment and the methods suitable to be used for making seasonal adjustment are the elements to be decided on when running the procedure.

The criteria of a “good” seasonal adjustment process are the following:

- series which does not show the presence of seasonality should not be seasonally adjusted,
- it should not leave any residual seasonality and effects that have been corrected (trading day, Easter effect, …) in the seasonally adjusted data,
- there should not be over-smoothing,
- it should not lead to abnormal revisions in the seasonal adjustment figure with respect to the characteristics of the series,
- the adjustment process should prefer the parsimonious (simpler) ARIMA models,
- the underlying choices should be documented.

Aggregation Approach

Setting up general rules concerning aggregation policy appears quite difficult, because the choice between direct and indirect approaches depend on a number of factors. The most important are user requests and data characteristics. Therefore the decision has to be made case by case. However, it is possible to set some guidelines (ECB (2000)).

Users are interested in preserving relationships between data. In this case the indirect approach is a solution to avoid inconsistencies in data. However, when the component series of an aggregate are adjusted on the basis of different models and identified outliers it cannot be expected the aggregation of the seasonally adjusted figures for the components to be equal to the seasonally adjusted figures for the aggregate.

An indirect adjustment is usually appropriate when the component series have very different seasonal patterns and many of the series can be seasonally adjusted individually.

It is necessary to consider how the original data are compiled. When the aggregates are the sum of components derived from different statistical sources, indirect adjustment is often preferable. When raw series are produced from one single source or are fully harmonised, the adjustment can be performed at a higher level of aggregation, since the decreasing sampling error leads to a lower variance at a higher aggregation level.

When the adjustment method is indirect, the adjustment of the aggregated series should be evaluated to make sure that there are no residual seasonal or trading day effects. If there are visually significant peaks, that adjustment should not be used, and the specifications should be changed to the direct adjustment.

In case of indirect adjustment a breakdown in the components of the seasonally adjusted aggregate is always possible.

A direct adjustment is usually appropriate when the series have very similar seasonal components observed because summing up the series together will first reinforce the seasonal pattern while allowing the cancellation of some noise in the series.

Direct adjustment of aggregate series may be useful when the individual components cannot be adjusted reliably.

The choice can be influenced by practical considerations, such as correlation of single components, quality of basic data. For more details see Astolfi, R., Ladiray, D., and Mazzi, G. L. (2003).

In case of direct adjustment, there are available benchmark techniques to ensure consistency between the data.

In general, the choice of aggregation approach should be explained.

Revision

Revisions of seasonally adjusted data could occur from several reasons: i.e. revision of the raw data, update of the seasonal estimation or when new observation become available.

From the user's point of view revisions of seasonally adjusted data are not welcomed. Frequent and large revisions cause data users to lose confidence in the usefulness of adjusted data. In general, the preferred alternative is to produce a more stable seasonally adjusted series in terms of revisions, nevertheless the accuracy of the recent data should not be left out of consideration. Less stable adjustment may lead to large revisions of the seasonally adjusted time series when additional data are available.

From a theoretical point of view concurrent adjustment is always preferred, for practical reasons the use of forecasting factors is often preferred. Therefore the choice between concurrent and projected adjustment depends on some criteria: the revision pattern of the raw data, the main use of the data, the stability of the seasonal component.

If the difference of the empirical revisions between the projected seasonal factors and the concurrent run is not significant, the projected adjustment should be chosen but in such cases it is not possible to construct reliable forecasts.

In the case of concurrent adjustment, data are revised every month or quarter, therefore all data of the series should be disseminated.

In revising raw data or knowing external information on changing seasonal pattern, seasonal adjustment estimates should be fully revised.

In the case of model based approaches the re-estimation of the parameters is carried out more frequently than the re-identification of models. Changes in the model specification should occur rarely (e.g. once a year), but revision of the model can be carried out irregularly during the year if revision concerning unadjusted raw data occurs. This can also occur when the diagnostics of the seasonal adjustment method indicate a significant deviation from the fixed model and parameters. In order to avoid large revisions coming from model and parameter fixing, it is advisable to re-estimate the parameters when new observation is appended.

Publication Policy

When seasonality is present and can be identified, series should be made available in seasonally adjusted form. The method and software used should be explicitly mentioned in the metadata accompanying the series. Calendar adjusted series and/or the trend-cycle estimates (in graph format) could be also disseminated in case of user demand.

Analytical transformations should be made to present further information about a time series. Press releases, presenting seasonally adjusted flow series, should contain period-to-period growth rates at minimum for the latest period.

For period-on-previous period growth rates, seasonally adjusted data is the best way of presenting information about a time series and for presenting short-term developments (independent from the irregular component).

For the growth rate with respect to the same period of previous year, the year-on-year changes should be applied to data adjusted for calendar effect, if this is not available, to raw data.

It would be very important to publish not only the final seasonal adjusted figures and analytical transformations, with the explicitly mentioned method and software used but also as much metainformation on the adjustment procedure as possible:

- the decision rules for the choice of different options in the program
- the aggregation policy
- the outlier detection and correction methods with explanation
- the decision rules for transformation
- the revision policy
- the description of the working/trading day adjustment
- and the contact address.

In more and more cases data are published with quality characteristics and quality reports as a part of documentation of metadata, therefore efforts should be made to implement quality reporting. (See Chapter 7).

If a series shows neither significant sign of seasonality nor calendar effects, the original series should be published as the seasonally and calendar effect adjusted series.

If a series does not show any sign of seasonality but sign of calendar effects, instead of seasonally adjusted series the calendar effect adjusted series should be published.

For the general public, a non-technical explanation of seasonal adjustment and its interpretation for the goodness should be published. (OECD (2006)).

Calendar Effects

Calendar effects are defined as any working or trading day, calendar and moving holiday effect.

Calendar adjustments can be carried out in a number of ways. One can distinguish between proportional and regression methods for adjustment. Under the proportional approach, the effects of trading days are estimated by counting the proportion of them on the month/quarter. Under the regression approach, the effects of trading days are estimated in a regression framework. Within the regression approach, the effect of trading days can be estimated by using or not a correction for the length of the month/quarter or leap year, regressing the series on the number of days from Monday to Saturday, or on the number of days from Monday to Friday and the number of days from Saturday to Sunday.

If possible the proportional approach should be avoided – especially in the case of model based methods.

The popular seasonal adjustment software provides many calendar correction options for users.

In the case of regression-based approach the plausibility of the effect should be checked in terms of sign and size of the estimated regression coefficients according to economic explanations.

Outlier's Detection

Outliers affect the quality of the forecast; the seasonal component and the trend. Therefore outliers should be removed before seasonal adjustment is carried out. There are many types of outliers, like additive outlier, transitory change, level shift. (For more details see Chapter 3.) The outliers can be stemming from the design of statistics and from the economic system. Outliers must be explained using all available information.

Outliers are estimated in most cases with ARIMA-models, and its effect depends on the choice of a particular model. The series should be checked for different types of outliers. Outliers due to data errors should be corrected in the time series of raw data, others should be excluded before seasonal adjustment is carried out and then reintroduced in the different components.

Expert information is especially important about outliers at the end of the series because the types of these outliers are uncertain from mathematical point of view and the change of type leads later to large revisions.

Transformation Analysis

The type of transformation influences the linkage of components (See Chapter 3).The most widely used software provide automatic test for log-transformation. The results of the automatic choice should be confirmed by looking at graphs of the series. If the diagnostics to choose between additive and multiplicative adjustments are inconclusive, you can choose to continue with the type of transformation used in the past to allow for consistency between years or it is recommended to visually inspect the graph of the series.

If the series has zero and negative values, this series must be additively adjusted.

If the series has a decreasing level with positive values close to zero and the series do not have negative values, multiplicative adjustment has to be used.

Time Consistency

When seasonal adjustment is applied to the sub-annual monthly or quarterly figures from the user's point of view, it is often desirable but unrealistic that the sum or average of only seasonally adjusted sub-annual figures corresponds to the sum or average of the unadjusted sub-annual figures, which in practice are not expected to coincide. Likewise, it is desirable but unrealistic that the sum or average of seasonally and calendar adjusted figures corresponds to the only calendar adjusted sub-annual figures. Time consistency of adjusted data should be maintained in case of strong user interest, but not if the seasonality is rapidly changing.

6.2 Seasonal Adjustment Step by Step

STEP 0 – Length of series

It is a requirement for seasonal adjustment that the time series has to be at least 3 year-long (36 observations) for monthly series and 4 year-long (16 observations) for quarterly series. If a series does not fulfil this condition, it is not long enough for seasonal adjustment. For an adequate seasonal adjustment data of more than five years are needed. For series under 10 years the instability of seasonally adjusted data could arise, in this case the users should be informed. On the other hand, in case of too long series, information regarding seasonality, many years ago could be irrelevant today, especially if changes in concepts, definitions and methodology occurred.

STEP 1 – Preconditions, test for seasonality

It is important to have a look at the data and graph of the original time series before running a seasonal adjustment method.

Series with possible outlier values should be identified. Verification is needed, to state whether the outliers are valid and there is not a sign problem in the data for example captured erroneously. In case of data errors, outliers should be corrected in the time series of raw data, before achievement of seasonal adjustment. Series with too many outliers (i.e. more than 10% irregular points to the series length) will cause estimation problems.

Missing observation(s) in the time series should be identified and explained. Series with too many missing values will cause estimation problems.

In case of an aggregate series, it should be verified that the starting and ending dates for all component series are the same.

X12 has got built-in seasonality tests: e.g. seasonal series should have M7 diagnostic closer to 0. Values around 1 imply that the series is marginally seasonal.

For a seasonal series, the spectrum of the original series should have peaks at one or more of the seasonal frequencies, particularly the first four seasonal frequencies (1/12, 2/12, 3/12 or 4/12) for monthly series. Therefore, the spectral graph of the original series should be examined.

If the spectrum (by X12 M7 diagnostics and F-test) does not indicate the presence of seasonality, the series is not seasonal, or its seasonality is not consistent enough for a seasonal adjustment. Such series should not be seasonally adjusted.

STEP 2 – Transformation type

In case of choice of transformation type, automatic test for log-transformation is recommended. The results of automatic choice should be confirmed by looking at graphs of the series. In case the diagnostics to choose between additive and multiplicative adjustments are inconclusive, see the general recommendations.

STEP 3 – Calendar effect

It should be determined which regression effects, such as trading/working day, leap year, moving holidays (e.g. Easter) and national holidays, are plausible for the series.

If the effects are not plausible for the series or the coefficients for the effect are not significant, the regressors for the effects should not be applied.

If the coefficients for the effects are marginally significant, they should be kept in the model only in case of established reasons (e.g. economic).

If the automatic test does not indicate the need for trading day regressor, but there is a peak at the first trading day frequency of the residuals' spectrum or there is another reason to keep the effects in the model, trading day regressor should be fitted manually.

If the series is long enough and the coefficients for the effect are highly significant, higher order regressor for the trading day effect should be used instead of one.

STEP 4 – Outlier correction

There are two possibilities to identify outliers. The first is when we identify series with possible outlier values as in STEP 1. If some outliers are marginally significant, it should be analyzed whether there is a reason to keep the outliers in model. The second possibility is when automatic outlier correction is used. The results should be confirmed by looking at graphs of the series, and any available information (economic, social, etc.) about the possible cause of the detected outlier should be taken into consideration.

High number of outliers (i.e. more than 10% irregular points to the series' length) signifies that there is a problem related to weak stability of the process, or that there is a problem with the reliability of the data.

Series with high number of outliers relative to the length of the series should be identified. In this case attempts can be made to re-model these series.

Expert information is especially important about outliers at the end of the series because the types of these outliers are uncertain from mathematical point of view and the change of type leads later to large revisions.

From period to period checks on the location of outliers should be made because they could occur not always at the same time and could cause large revisions.

STEP 5 – The order of the ARIMA model

Changes in the model specification can occur rarely (e.g. once a year), in these cases automatic procedure should be used. If the results of the automatic model identification are not plausible, the following manual procedure is advisable:

Not significant high-order ARIMA model coefficients should be identified. It can be useful to simplify the model by reducing the order of the model, taking care not to skip lags of autoregressive models. For moving average models, it is not necessary to skip model lags whose coefficients are not significant. Before choosing an MA model with skipped lag, the full-order MA model should be fitted and it is necessary to skip a lag only if that lag's model coefficient is not significantly different from zero.

The BIC and AIC statistics should be looked at in order to confirm the global quality of fitting statistics.

STEP 6 for family X – Filter choices

The critical X11 options in X12-ARIMA are those that control the extreme value in the X11 module and the trend and seasonal filters used for seasonal adjustment.

It should be verified that the seasonal filters are generally in agreement with the global moving seasonality ratio. (see Annex IV.)

After reviewing the seasonal filter choices, the seasonal filters in the input file should be set to the specific chosen length so they will not change during the production.

The SI-ratio Graphs in the X12-ARIMA output file should be looked at. Any month with many extreme values relative to the length of the time series should be identified. This may be needed for raising the sigma limits for the extreme value procedure.

STEP 7 – Monitoring of the results

There should not be any residual seasonal and calendar effects in the published seasonally adjusted series or in the irregular component. If there is residual seasonality or calendar effect, as indicated by the spectral peaks, the model and regressor options should be checked in order to remove seasonality.

In case of an indirect adjusted aggregated series there should not be any presence of seasonality and there should not be left any residual seasonality. If there are visually significant peaks the specifications should be changed to the direct adjustment.

The spectral graph of the seasonally adjusted series and the irregular component could be looked at. Among others the diagnostics of normality and Ljung-Box Q-statistics should be looked at in order to check the residuals of the model.

STEP 8 – Stability diagnostics

Even if no residual effects are detected, the adjustment will be unsatisfactory if the adjusted values undergo large revisions when they are recalculated as new data become available. In any case instabilities should be measured and checked.

X12-ARIMA includes two types of stability diagnostics: sliding spans and revision history. For other indicators see Annex VI.

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7 Proposal for a Quality Report on Seasonal Adjustment

7.1 About Quality Reports

Quality reporting is the preparation and dissemination of reports conveying information about the quality of a statistical product or survey on a regular or irregular basis (Eurostat (2003)).

Quality reports and indicators provide documentation of the quality features of statistical products. They are the key reference documents for quality assessment.

Quality reports are important for users and producers of official statistics. Users of official statistics need to have access to a range of relevant quality measures and indicators in order to understand the strengths and limits of the statistics and to know how to use them properly. Producers need to have a picture on the product quality in order to see the results of the earlier production developments and to identify the points of further improvements. To this end they need the most detailed quality reports and a number of indicators, involving the processes behind.

The quality requirements and the statistical expertise of these user groups are different and therefore a single quality report will not satisfy all of them, however a standard structure is preferable. The standard structure makes easier to find the useful and user specific relevant information, and helps comparability over time or among products.

Data producers have to compile quality report to characterise the quality dimensions, and search for indicators to illustrate these features, taking into account that different users have different needs concerning quality information.

In the European Statistical System, quality of statistics is assessed according to the ESS quality components. Brief description of these components follows.

Relevance

Relevance is the degree to which statistics meet current and potential users' needs. It refers to whether all needed statistics are produced and the extent to which concepts used (definitions, classifications etc.) reflect user needs.

It is a well known fact that users' scope can change, and they can be inconstant and be easily influenced by short-term effects. Users' needs are therefore volatile and unpredictable over time.

The satisfaction of users' needs is the number one priority of statistical organisations. By the evaluation it must be taken into account who the users are, and what the strategic importance of their needs are.

Accuracy

In the general statistical sense accuracy indicates the closeness of computations or estimates to the (unknown) exact or true values. Statistics are not equal with the true values because of variability (the statistics change from implementation to implementation of the process due to random effects) and bias (the average of the possible values of the statistics from implementation to implementation is not equal to the true value due to the systematic effects).

Timeliness and Punctuality

Timeliness of information reflects the length of time between its availability and the event or phenomena it describes.

Punctuality refers to the time lag between the release date of data and the target date on which they should be delivered, for instance, with reference to the dates announced in official release calendar, laid down by regulations or previously agreed among stakeholders.

Punctuality and timeliness are connected with the frequency of released statistics.

Accessibility and Clarity

Accessibility refers to the physical conditions in which users can obtain data: where to go, how to order, delivery time, clear pricing policy, convenient marketing conditions, availability of micro or macro data, various formats (paper, files, CD, Internet, …), etc.

Clarity refers to the information environment of data; whether data are accompanied with appropriate metadata; illustrations, such as graphs and maps, whether information on their quality is also available and the extent to which additional assistance is provided by the NSI.

Accessibility and clarity refer to the simplicity and easiness for users to access statistics using simple and user-friendly procedures, in the form expected by them, and within an acceptable time period, with the appropriate user information and assistance: a global context which finally enables them to make optimum use of the statistics.

Comparability

Comparability aims at measuring the impact of differences in applied concepts and measurement tools/procedures when statistics are compared between geographical areas, non-geographical domains, or over time. These are three main approaches under which comparability of statistics is normally addressed.

Geographical comparability refers to the degree of comparability between similar surveys that measure the same phenomenon and that are conducted by different statistical agencies and refer to populations in different geographical entities. If there are differences in concepts of methods or the applications of them, the results cannot be fully comparable.

Comparability over time refers to the degree of comparability between two survey instances. In this case any changes in concepts and methods between two survey instances can render estimates not fully comparable.

Comparability between domains reflects similar characteristics for different domains that are measured by different surveys.

Coherence

Coherence of statistics is their adequacy to be reliably combined in different ways and for various uses.

When originating from different sources, and in particular from statistical surveys of different nature and/or frequencies, statistics can not be completely coherent in the sense that they are based on different approaches, classifications and methodological standards.

For many characteristics, statistics have to be produced with both infra-annual and annual frequencies. These statistics are often produced according to different methodologies. However, it is important for users that certain coherence should exist between both sets of information.

Cost and Burden

The last quality reporting aspects could be the cost and burden although they are not quality dimensions but very important aspects of quality assessment.

In order to satisfy the requirements of the different users, – internal/external, expert/non-expert ones, – it is advisable to develop several quality reports to meet their needs. The different types of quality reports can be sorted by the aspect, i.e. level of details. The elements of the above mentioned quality components can be considered as a Full Quality Report, and can be regarded as a broad framework to compile a user-oriented Summary or Basic Quality Report through selection of the relevant parts.

Quality profile is a special type of quality reports in the ESS, it is a user-oriented summary of the main quality features of policy-relevant indicators, as a special type of data.

7.2 Quality Report concerning Seasonal Adjustment

Many National Statistical Institutes and international organisations have defined guidelines and recommendations for ensuring the quality of the SA process and their output. The two main proposals came from the European Central Bank (ECB (2000)) and from Eurostat (2002). Both of them set up a Task Force for Seasonal Adjustment.

ECB stressed the importance of transparency and good documentation of any transformed data, especially those with a high level of technical input such as seasonally adjusted data. A detailed description of the general principles and methodologies of seasonal adjustment at the ECB was given in "Seasonal adjustment of monetary aggregates and HICP for the euro area". In 2003 a data quality report (ECB (2003)) was developed which is a useful instrument for supporting decisions on seasonal adjustment options and ensuring that proper documentation is available to data users. The limitation of the quality report is its format, some proposal were made to increase its flexibility and content accessibility.

At Eurostat an Informal working group on Seasonal Adjustment has been set up. A proposal was submitted for a Quality Report for Seasonal Adjustment. Some important characteristics of a Quality Report are highlighted: it should be fully automatic, largely independent from the software and easy to use and interpret. Museaux and Jukic (2003) defined a method-independent quality report which focuses on the SA process which is crucial at the ESS level. Since then a Steering Group was set up, which has a management – co-ordination function for Seasonal Adjustment tools development for the ESS and ESCB. In the field of methodological harmonisation, it proposes improvement actions and monitoring their implementation.

The implementation of a standard quality report needs special expertise. Both seasonal adjustment experts and users should work together. The use of Eurostat quality concept is recommended, because Eurostat is a user of Member States data and data producer at European level. Therefore we have compiled a quality concept meeting Eurostat needs.

This part of the section deals with the quality of seasonal adjustment. The indicators given in the next section are the basis for measurement of seasonally adjusted data. Most of these indicators are rooted in the seasonal adjustment process because there is a strong relationship between the product indicators and the process variables.

The proposal for the Detailed or Full Quality Report Structure from chapter to chapter might be the following.

1. Administrative & General information

In this chapter administrative information can be found, i.e. the name of the time series, the reference period, the periodicity of the survey, the responsible person (or unit) and some important issues about the statistical product. As general information a description of the methods and software used, the source of the input data, and the type of outlier and calendar effect detection as the pre-treatment of seasonal adjustment are presented. Missing observations with explanations should be indicated in this chapter.

2. Relevance

Relevance measures the degree of ***satisfaction of users*** according to seasonally adjusted data. Therefore this report should contain a users' ***classification and description***.[20] ***Users' needs*** should be translated into appropriate statistical terminology, it should be taken into account who the users are and how their satisfaction should be evaluated. The most efficient method for measuring users' satisfaction is to carry out a user satisfaction survey, but this method is costly. Therefore other methods and approaches to measure users' needs should be applied.

3. Accuracy

Accuracy cannot be characterised ideally by seasonal adjustment, because a 'true' seasonal adjusted value does not exist. As several elements and choices (i.e. method used, choice of the model, identification and estimation of outliers and calendar effects) influence the results, an optimal approach cannot be defined. Very often the choices depend on different considerations that do not have any theoretical basis. And last but not least we must not forget that the accuracy of seasonally adjusted data are highly dependent on the original data.

In this part of the report the properties of the pre-treatment should be mentioned. In the case of outliers the date, the type and the significance level of the outlier(s) with linked to the corresponding comparability characteristics are important. The so-called regression effects (i.e. trading/working day, Easter effect, Leap year) with the same characteristics like in case of the outliers are important for the estimation of seasonal components.

This part of the report should be a combination of ***figures*** and ***tables***. The figures have to present the original time series and the seasonally adjusted time series, as well as seasonal and irregular components. Other figures like comparison of direct and indirect or concurrent vs. projected factors should be included. The tables have to show the ***set of options*** used during the adjustment, the parameters and coefficients, as well as the tests for the models and seasonal adjustment and the main indicators for accuracy, the absolute and relative ***size of revisions***, which should be measured in every case. For other indicators see the table in the next section.

Statistics Sweden proposes the following criteria for any seasonally adjusted statistics: uncertainty in seasonal adjustment stemming from the choice of different models should be measured by the superpopulation approach. For more details see Öhlén (2006).

4. Timeliness and Punctuality

Timeliness is the main requirement from the users' point of view, because they require data as soon as possible. In case of seasonal adjustment this requirement depends mainly on the timeliness of the original data, but ***dates of transmission*** should be noted.

Therefore in the case of seasonal adjustment the punctuality should be measured which refers to the ***time lag*** (in days) between the release date of seasonally adjusted data and the target date on which they should be delivered and the ***reason for late delivery***.

[20] For an example see Eurostat (2003).

5. Accessibility and Clarity

Accessibility is measured by the number of downloads of the database and clarity is highly linked to the number of availability accompanying information. Therefore this chapter should contain a ***list of type and frequency of publication*** of the seasonally adjusted data, a description of ***the conditions of access*** to data (i.e. media, marketing conditions) and a summary description of the ***information accompanying the seasonally adjusted data***.

6. Comparability

Comparability aims at measuring the differences over time, space and domain. As the seasonally adjusted data are influenced by the raw data, this quality component regards mainly the raw data. In this case considering the ***comparability of original data*** is also proposed. However, seasonally adjusted data are highly dependent on the seasonal adjustment method used. Any ***changes in the method*** cause changes in the data and consequently in the time series but follow-up and application of the scientific results are also important.

7. Coherence

Coherence of statistics is their adequacy to be reliably combined in different ways and for various uses. In case of seasonal adjustment we can measure the coherence between provisional and final seasonal adjusted data. Imposing time consistency has no scientific justification but deteriorates the quality of results.

8. Additional Aspects - Optional

The implementation of seasonal adjustment depends on the IT structure, computer and software resources, which could affect the output. For this reason the software and source-code should be mentioned in the report.

Some special aspects, like cost and burden, which effect quality, should be included in the quality report.

The preparation and updating of quality reports are depending on the frequency of surveys and stability of the characteristics, balancing between the needs for up-to-date information and report compiling burden. If the characteristics are stable, the inclusion of the quality indicators on the newest survey results could be enough to update the report. Another solution is to provide a detailed quality report less frequently (i.e. yearly), and a shorter one at each process just covering the updated characteristics, like some accuracy-related indicators.

7.3 Quality Measures for Seasonal Adjustment

The proposed key quality indicators according to the six quality components are presented in the table below. The following indicators can be regarded as a framework, where the elements are not fixed, new indicators can be added, and can be extracted to the levels of the quality report.

Table 23. Proposed quality indicators

Quality component	Proposed indicator
Relevance	User satisfaction index
Accuracy	Original data visual check
	Comparison of the original and seasonally adjusted data
	Length of series
	Analysis of Variance (ANOVA)
	Stability of Trend and Adjusted Series Rating (STAR)
	Number of model revisions during a year
	Number of parameter revisions during a year
	Relative size of revision
	Absolute size of revision
	Tests on residuals
	M and Q statistics
	Significant regressors with coefficients and t-values
	Number of non-significant regressors
	ARIMA model with coefficients and t-values
	Information Criteria
	Forecast error
Timeliness and punctuality	Punctuality of time schedule of effective publication
Accessibility and clarity	Number of database accesses
	Number of accompanying information
Comparability	Number of changes in methods relative to the series' length
	Number of main divergences between the national and European concepts
	Graph of Seasonal-Irregular (SI) ratios
	Months (or Quarters) for Cyclical Dominance
	Contingency Table Q
Coherence	UAPE (unbiased absolute percentage of error) between the provisional and final seasonal adjusted data
	Comparison of annual totals before and after seasonal adjustment
	Taking into account time consistency

For the calculation of these indicators see ANNEX VI.

One of the main recent developments might be the establishment of a set of quality indicators for seasonally adjusted series, which are accepted from the NSIs, NCBs, Eurostat and ECB.

Statistics Sweden propose a numeric quality measure, which will be given in 2007, and will be constructed in lines with

$$QM = \sum w_{ui} Q_{ci} + \sum w_{si} Q_{si} \text{ ,}$$

where Q_{ui} = User quality component,

Q_{si} = Scientific quality component,

w_{ui} = Weights of importance for the user quality component,

w_{si} = Weights of importance for the scientific quality component,

$\sum w_{si} + \sum w_{ui} = 1$.

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ANNEX I.

Questionnaire for Handbook on Seasonal Adjustment

I. Seasonal Adjustment methods and Dissemination Policy
(***multiple answers are possible***)

1. Is there a unified seasonal adjustment procedure in your office/organisation?

Yes ☐ since
Yes, on department/unit level ☐
No ☐
Other (please specify)

2. Is there a seasonal adjustment expert group in your office/organisation?

Yes ☐
No ☐
Other (please specify)

3. Has your office any methodological description about seasonal adjustment?

Yes ☐
No ☐
Is in progress ☐
Is scheduled ☐
Other (please specify)

4. Which of the following method(s) is (are) used in your organisation for the SA?

	Currently used	No more used	Planned
TRAMO/SEATS	☐	☐	☐
X12-ARIMA	☐	☐	☐
X11-ARIMA	☐	☐	☐
X13-ARIMA/SEATS	☐	☐	☐
Other (please specify)			

5. Why are you using this method(s)?

Recommended method (by Eurostat) ☐
Historical reasons ☐
Decision after internal testing and evaluation ☐
Other reasons (please specify)

6. If you use more methods, why?

Advantage of specific features ☐
Depends on lengths of time series ☐
Possibility of cross-checking ☐
Historical reasons ☐
Other reasons (please specify)

7. What kind of software do you use? Please specify the version number!

Software		Version
Demetra	☐	
TRAMO/SEATS	☐	
X12-ARIMA	☐	
Other (please specify)	☐	

8. How many series are adjusted in your office or/and in your unit? Please give detailed information about the series and number of observations.

Level		Number of time series	Min. number of obs.	Max. number of obs.	Average number of obs.	Comments
In the whole office	Monthly					
	Quarterly					
In your unit	Monthly					
	Quarterly					
Other,	Other,					

9. Do you use projected or concurrent adjustment?

Projected adjustment ☐
Concurrent adjustment ☐

10. How often do you update the models and parameters in the SA procedure?

Update	New observations append	Once a year	Other periodicity (in month)	Other/ Comments
Model	☐	☐		
Parameter	☐	☐		
Other,	☐	☐		
Other,	☐	☐		

11. For how many of your series do you aggregate with the following methods?

	All	>75%	50-75%	25-50%	<25%	None
Direct	☐	☐	☐	☐	☐	☐
Indirect	☐	☐	☐	☐	☐	☐
Mixed	☐	☐	☐	☐	☐	☐
Other,	☐	☐	☐	☐	☐	☐

12. What is the main practice in the transformation of the data?

Test for log-transformation ☐
In most cases logarithm ☐
None ☐
In most cases other transformation (please specify)
Comments

13. Which regressors do you take in consideration?

	Test and consider	Consider independent from the t-value	Isn't in consideration	Comments
Trading day (TD)	☐	☐	☐	
Trading day (TD) & Specific holidays	☐	☐	☐	
Working day (WD)	☐	☐	☐	
Working day (WD) & specific holidays	☐	☐	☐	
Leap-year (LY)	☐	☐	☐	
Easter (EE)	☐	☐	☐	
Other, (please spec.)	☐	☐	☐	

14. Did it occur that the t-value of the LY was significant and the WD/TD wasn't? How did you solve the problem?

Yes ☐ Solution:
No, never ☐
Other special problem: Solution:

15. Which types of outliers are taken in consideration?

Additive outlier ☐
Temporary change ☐
Level shift ☐
Others (please specify)

16. How do you detect these types of outliers?

Always by test ☐
In most cases by test ☐
In most cases experts define ☐
Only experts define ☐
Other (please specify)

17. What do the experts validate during the seasonal adjusting process?

The outliers ☐
The type of transformation ☐
The regressors ☐
The result ☐
Nothing ☐
Others (please specify)

18. What do you apply the seasonal adjusted time series to?

To publishing ☐
To imputing ☐
To validating ☐
To forecasting ☐
To others (please specify)

19. What type of data do you publish?

Raw data ☐
SA data ☐
Trend ☐
Working-day adjusted data ☐
Others

20. What type of metainformation do you publish?

Type of meta information	For internal usage	For external usage	For Eurostat	Comments
The method(s) used	☐	☐	☐	
The parameters used in the SA	☐	☐	☐	
The working/trading day adjustment applied	☐	☐	☐	
Documentation about events explaining outliers	☐	☐	☐	
Other metadata				
Other information				

21. On which media do you disseminate the data?

- Paper publications ☐
- Internet publications ☐
- CD-ROMs ☐
- Reference databases ☐
- Ad hoc users' queries ☐
- Other (please specify) ☐

22. Please specify some problem with its solution in connection with seasonal adjustment!

Problem:	Solution:
Problem:	Solution:
Problem:	Solution:

II. The Quality of Seasonal Adjustment process

(*multiple answers are possible*)

23. Which are the most used indicators to evaluate quality of the SA process? (rating from 1 for 'not relevant' to 5 for 'very significant')

	Not used	Rating					Comments
		1	2	3	4	5	
a. Graphical inspection	☐	☐	☐	☐	☐	☐	
b. Autocorrelation function	☐	☐	☐	☐	☐	☐	
c. Statistics on residuals	☐	☐	☐	☐	☐	☐	
d. Fit statistics	☐	☐	☐	☐	☐	☐	
e. Stability over time	☐	☐	☐	☐	☐	☐	
Others (please specify)		☐	☐	☐	☐	☐	
		☐	☐	☐	☐	☐	
		☐	☐	☐	☐	☐	

23 /a. What measures do you use in the graphical inspections?
(if the answer in **23.a.** was not used skip to **23.b.**)

- Mean and standard deviation of the raw and SA series ☐
- Standard deviation relative to trend ☐
- MCD/QCD statistics (a volatility measure) ☐
- Intuitively on face of it ☐
- Other (please specify)

23 /b. What do you examine in terms of the autocorrelation pattern?
(if the answer in **23.b.** was not used skip to **23.c.**)

- The significant peaks of the autocorrelogram of the raw series. ☐
- The Box-Pierce statistics for seasonality ☐
- F-test for seasonality ☐
- Other (please specify)

23 /c. Which statistics on residual do you use for quality of ARIMA modelling?
(if the answer in **23.c.** was not used skip to **23.d.)**

- Ljung-Box Q-statistics ☐
- Ljung-Box Q-statistics for squared residuals ☐
- Box-Pierce Q-statistics ☐
- Box-Pierce Q-statistics for squared residual ☐
- Normality test ☐
- Other (please specify)

23 /d. What kind of fit statistics do you provide in your practice?
(if the answer in **23.d.** was not used skip to **23.e.**)

- AIC ☐
- AICC ☐
- BIC ☐
- Other (please specify)

23 /e. Do you examine the stability of the results over time?
(if the answer in **23.e.** was not used skip to **24.**)

- Every time ☐
- In special case (please specify) ☐
- Never ☐
- Comments

24. Do you use a quality measure for the results?

- M-Statistics ☐
- SA quality index ☐
- No ☐
- Other (please specify)

General additional comments:

ANNEX II.

Data Tables

OECD survey in 2002 and HoSA survey in 2006

Q1. Is there a unified seasonal adjustment procedure in your office/organisation?						
Country	**Answer**	**Yes**	**Since**	**Yes, on department/unit level**	**No**	**Other**
Austria	2			×		
Belgium						
Denmark	1	×				
Finland	3			×		
France	5			×	×	
Germany	1					×[1]
Greece	1	×	1999			
Ireland	1			×		×[2]
Italy	2	×	1998			
Luxembourg	1			×		
Netherlands	1	×	2003			
Portugal	2				×	
Spain	2			×	×	
Sweden	1			×		×[3]
United Kingdom	1	×	1996			
EU-15 Total	14	5		7	3	3
%	**93%**	**36%**		**50%**	**21%**	**21%**
Bulgaria	2			×		
Cyprus	1				×	
Czech Republic	2			×		
Estonia	1				×	
Hungary	1	×	2002			
Latvia	1			×		
Lithuania	1	×	2001			
Malta	1			×		
Poland	1	×	2005			
Romania	1			×		
Slovak Republic	9			×		
Slovenia	1	×	1999			
NMS-12 Total	12	4		6	2	0
%	**100%**	**33%**		**50%**	**17%**	**0%**
Croatia	3			×		
Iceland	1				×	
Norway	1	×	1980			
Switzerland	1	×	2004			
Turkey	1				×	
Non-EU Total	5	2		1	2	0
%	**100%**	**40%**		**20%**	**40%**	**0%**
Total answers	31	11		14	7	3
Answers as % of total	**97%**	**35%**		**45%**	**23%**	**10%**

[1] All time series are decomposed by the BV4.1 procedure. In cooperation with the national central bank, most time series are also seasonally adjusted by X12-ARIMA.
[2] Business units seasonally adjust independently, but a common method has emerged.
[3] There is a unified seasonal adjustment procedure in QNA.

Q2. Is there a seasonal adjustment expert group in your office/organisation?				
Country	**Answer**	**Yes**	**No**	**Other**
Austria	2	×		
Belgium				
Denmark	1	×		
Finland	3	×		
France	6	×		
Germany	1			×[1]
Greece	1		×	
Ireland	1		×	
Italy	2		×	
Luxembourg	1	×		
Netherlands	1	×		
Portugal	2		×	
Spain	2		×	×[2]
Sweden	1	×		
United Kingdom	1	×		
EU-15 Total	14	8	5	2
%	**93%**	**57%**	**36%**	**14%**
Bulgaria	2		×	
Cyprus	1		×	
Czech Republic	2			×[2]
Estonia	1		×	
Hungary	1	×		
Latvia	1		×	
Lithuania	1	×		
Malta	1	×		
Poland	1			×[3]
Romania	1	×		
Slovak Republic	9			×[3]
Slovenia	1	×		
NMS-12 Total	12	5	4	3
%	**100%**	**42%**	**33%**	**25%**
Croatia	3		×	
Iceland	1		×	
Norway	1			×[2]
Switzerland	1			×[3]
Turkey	1		×	
Non-EU Total	5	0	3	2
%	**100%**	**0%**	**60%**	**40%**
Total answers	31	13	12	7
Answers as % of total	**97%**	**42%**	**39%**	**23%**

[1] Expert group for general methodological questions and for the BV4.1 procedure.
[2] Each department has an SA expert.
[3] One chief methodologist.

Q3. Has your office any methodological description about seasonal adjustment?					
Country	**Answer**	**Yes**	**No**	**Is in progress**	**Is scheduled**
Austria	2	×	×		
Belgium					
Denmark	1	×			
Finland	3	×			
France	6			×	
Germany	1	×			
Greece	1	×			
Ireland	1		×		
Italy	2	×			
Luxembourg	1	×			
Netherlands	1	×			
Portugal	2	×	×		
Spain	2	×			
Sweden	1	×			
United Kingdom	1	×			
EU-15 Total	14	12	3	1	0
%	**93%**	**86%**	**21%**	**7%**	**0%**
Bulgaria	2		×		
Cyprus	1		×		
Czech Republic	2	×			
Estonia	1		×		
Hungary	1	×			
Latvia	1			×	
Lithuania	1	×			
Malta	1			×	
Poland	1	×			
Romania	1	×			
Slovak Republic	8	×			
Slovenia	1	×			
NMS-12 Total	12	7	3	2	0
%	**100%**	**58%**	**25%**	**17%**	**0%**
Croatia	3	×			
Iceland	1			×	
Norway	1	×			
Switzerland	1	×			
Turkey	1		×		
Non-EU Total	5	3	1	1	0
%	**100%**	**60%**	**20%**	**20%**	**0%**
Total answers	31	22	7	4	0
Answers as % of total	**97%**	**71%**	**23%**	**13%**	**0%**

Q4. Which of the following method(s) is (are) used in your organization for SA?														
Country	**Ans**	**Currently used**				**No more used**				**Planned**[1]				
		T/S	**X11**	**X12**	**Other**	**T/S**	**X11**	**X12**	**Other**	**T/S**	**X11**	**X12**	**X13**	**Other**
Austria	4	×	×	×						×		×		
Belgium														
Denmark	1	×		×			×			×			×	
Finland	3	×		×			×			×				
France	8	×	×	×						×	×	×	×	
Germany	1			×	BV4.1		×		BV4			×		
Greece	1	×								×				
Ireland	1		×								×			
Italy	2	×					×			×				
Luxembourg	1	×											×	
Netherlands	1			×			×					×		
Portugal	2	×		×						×		×		
Spain	2	×								×				
Sweden	1	×	×	×									×[2]	×
United	1		×	×									×	
EU-15 Total	14	10	5	9	1	0	5	0	1	8	2	5	5	1
%	**93%**	**71%**	**36%**	**64%**	**7%**	**0%**	**36%**	**0%**	**7%**	**57%**	**14%**	**36%**	**36%**	**7%**
Bulgaria	2	×								×				
Cyprus	1	×	×							×				
Czech Rep.	2	×		×	Dainties								×	
Estonia	1	×		×						×		×		
Hungary	1	×								×				
Latvia	1	×								×				
Lithuania	1	×		×			×						×	
Malta	1	×								×				
Poland	1	×								×				
Romania	1	×								×				
Slovak Rep.	9	×								×				
Slovenia	1	×								×				
NMS-12 Total	12	12	1	3	1	0	1	0	0	10	0	1	2	0
%	**100%**	**100%**	**8%**	**25%**	**8%**	**0%**	**8%**	**0%**	**0%**	**83%**	**0%**	**8%**	**17%**	**0%**
Croatia	3	×		×			×			×		×		
Iceland	1	×		×									×	
Norway	1			×			×			×			×	
Switzerland	1			×								×		
Turkey	1	×								×				
Non-EU Total	5	3	0	4	0	0	2	0	0	3	0	2	2	0
%	**100%**	**60%**	**0%**	**80%**	**0%**	**0%**	**40%**	**0%**	**0%**	**60%**	**0%**	**40%**	**40%**	**0%**
Total answers	31	25	6	16	2	0	8	0	1	21	2	8	9	1
Answers as % of total	**97%**	**81%**	**19%**	**52%**	**6%**	**0%**	**26%**	**0%**	**3%**	**68%**	**6%**	**26%**	**29%**	**3%**

[1] In the case of non-response, the currently used method(s) was (were) considered.
[2] Under consideration.

Q5. Why are you using this method(s)?					
Country	**Answer**	**Recommended method**	**Historical reasons**	**Decision after internal testing and evaluation**	**Other reasons**
Austria	2	×	×		×[1]
Belgium					
Denmark	1	×	×	×	
Finland	3	×		×	×[2]
France	8	×	×	×	×[3]
Germany	1	×	×		×[4]
Greece	1			×	
Italy	2			×	
Ireland	1		×		
Luxembourg	1	×			
Netherlands	1			×	
Portugal	2	×		×	
Spain	2	×		×	
Sweden	1	×	×	×	
United Kingdom	1			×	
EU-15 Total	14	9	6	11	4
%	**93%**	**64%**	**43%**	**79%**	**29%**
Bulgaria	2	×		×	
Cyprus	1	×	×		
Czech Republic	2	×		×	
Estonia	1	×			
Hungary	1	×		×	
Latvia	1	×		×	
Lithuania	1	×	×	×	
Malta	1	×			
Poland	1	×		×	
Romania	1	×			
Slovak Republic	9	×		×	
Slovenia	1	×			
NMS-12 Total	**12**	**12**	**2**	**7**	**0**
%	**100%**	**100%**	**17%**	**58%**	**0%**
Croatia	3	×			
Iceland	1	×		×	
Norway	1		×	×	
Switzerland	1	×		×	
Turkey	1	×			
Non-EU Total	5	4	1	3	0
%	**100%**	**80%**	**20%**	**60%**	**0%**
Total answers	31	25	9	21	4
Answers as % of total	**97%**	**81%**	**29%**	**68%**	**13%**

[1] Theoretical properties.
[2] Easy to use, especially when calendat effects are needed.
[3] Retail Trade series were bimonthly and only Tramo-Seats could at that time handle this periodicity. A lot of applications are developped in SAS which is a standard software in our organisation, therefore it was quite natural to use the SAS PROC X11 to seasonally adjust the figures.
[4] X12-ARIMA is used to be in line with other national organisations (e.g. National Central Bank).

Q6. If you use more methods, why?						
Country	**Answer**	**Advantage of specific features**	**Depends on lengths of time series**	**Possibility of cross-checking**	**Historical reasons**	**Other reasons**
Austria	2		×	×		
Belgium						
Denmark	1	×				
Finland	2				×	×[1]
France	5	×		×		×[2]
Germany	1	×		×		×[3]
Greece						
Ireland						
Italy						
Luxembourg						
Netherlands						
Portugal						
Spain						
Sweden	1	×	×		×	
United Kingdom						
EU-15 Total	6	4	2	3	2	3
%	**40%**	**67%**	**33%**	**50%**	**33%**	**50%**
Bulgaria						
Cyprus	1	×			×	
Czech Republic	1				×	×[4]
Estonia						
Hungary						
Latvia						
Lithuania	1		×			
Malta						
Poland						
Romania						
Slovak Republic						
Slovenia						
NMS-12 Total	3	1	1	0	2	1
%	**25%**	**33%**	**33%**	**0%**	**67%**	**33%**
Croatia	1	×				
Iceland						
Norway						
Switzerland						
Turkey						
Non-EU Total	1	1	0	0	0	0
%	**20%**	**100%**	**0%**	**0%**	**0%**	**0%**
Total	10	6	3	3	4	4
Answers as % of total	**31%**	**60%**	**30%**	**30%**	**40%**	**40%**

[1] They are moving from X12-Arima to Tramo/Seats.
[2] The X11 software available in SAS does not allow for an automatic detection and correction of non-linearities. This is why some units moved to Tramo-Seats or X12-ARIMA (production application permitting).
[3] To make users sensitive to the fact that there exists no 'true' analysis results. Seasonal adjustments are based on assumptions and so on different assumptions lead to different results.
[4] Requeired by DF ECFIN in contract regarding Business Cycle Surveys.

Q7. What kind of software do you use? Please specify the version number!										
Country	Ans	Demetra		TRAMO/SEATS		X12-ARIMA		Other		
		Demetra	Version	T/S	Version	X12-ARIMA	Version	Software	Using	Version
Austria	2	×	2,04			×	0,2	X11	×	
Belgium										
Denmark	3	×	2	×		×	2.1			
Finland	2	×	2,03; 2,04	×	1.0.4; DOS					
France	8	×	2,04	×		×	2.1	SAS	×	V8
Germany	2					×	0.2.8	BV	×	4.1
Greece	1	×	2							
Ireland	1							SAS	×	V8,2
Italy	1			×	2005; DOS					
Luxembourg	1	×	2							
Netherlands	1					×	2.1			
Portugal	1	×	2,04							
Spain	1			×	1.0.4, 2004					
Sweden	3	×	2,04	×	1996			SAS	×	
United Kingdom	2					×	0,3	X11	×	88
EU-15 Total	14	8	8	6	4	6	6	6	6	4
%	**93%**	**57%**	**57%**	**43%**	**29%**	**43%**	**43%**	**43%**	**43%**	**29%**
Bulgaria	2	×	2,01							
Cyprus	2			×				X11	×	
Czech Rep.	1	×	2,04							
Estonia	1	×	2,04							
Hungary	1	×	2,04							
Latvia	2	×	2,04	×	1.0.4					
Lithuania	1	×	2,04							
Malta	1	×	2							
Poland	1	×	2,04							
Romania	1	×	2,04							
Slovak Rep.	1	×	2,04							
Slovenia	1	×	2,04							
NMS-12 Total	12	11	11	2	1	0	0	1	1	0
%	**100%**	**92%**	**92%**	**17%**	**8%**	**0%**	**0%**	**8%**	**8%**	**0%**
Croatia	1	×	2; 2,04							
Iceland	2	×	2,04	×	1,04					
Norway	1					×	2.1			
Switzerland	1					×	2002			
Turkey	1	×	2,04							
Non-EU Total	5	3	3	1	1	2	2	0	0	0
%	**100%**	**60%**	**60%**	**20%**	**20%**	**40%**	**40%**	**0%**	**0%**	**0%**
Total answers	31	22	22	9	6	8	8	7	7	4
Answers as % of total	**97%**	**71%**	**71%**	**29%**	**19%**	**26%**	**26%**	**23%**	**23%**	**13%**

Q8. How many series are adjusted in office?									
Country	Answer	In the whole office / Monthly				In the whole office / Quarterly			
		Number of time series	Min. number of observations	Max. number of observations	Average number of observations	Number of time series	Min. number of observations	Max. number of observations	Average number of observations
Austria									
Belgium									
Denmark									
Finland									
France	1	3500				3000			
Germany	1	5500	60			350	20		
Greece	1	3	36	84	60	3	12	28	20
Ireland	1	306	72	120	110	274	24	43	31
Italy	2	208	100	300	200	240	20	100	50
Luxembourg	1	300	36	170	100	150	20	40	25
Netherlands	1	460	48	240	165	190	20	86	44
Portugal									
Spain									
Sweden	1	500	192	192	192	200	52	52	52
United Kingdom	1	5000+	60	180	120	5000+	20	60	40
EU-15 Total	9	9	8	7	7	9	8	7	7
%	**60%**	**100%**	**89%**	**78%**	**78%**	**100%**	**89%**	**78%**	**78%**
Bulgaria									
Cyprus									
Czech Republic									
Estonia	1	32	102	138	115	411	20	52	41
Hungary	1	315	72	168	96	122	24	44	40
Latvia	1	132	52	122	95	359	24	44	32
Lithuania	1	84	72	108		265	36	54	
Malta									
Poland	1	215	60	134	132	53	24	44	34
Romania									
Slovak Republic									
Slovenia	1	206	37	157	91	203	22	41	38
NMS-12 Total	6	6	6	6	5	6	6	6	5
%	**50%**	**100%**	**100%**	**100%**	**83%**	**100%**	**100%**	**100%**	**83%**
Croatia	1	31	97	169	119	13	32	48	36
Iceland	1					8	36	36	36
Norway	1	ca500				ca500			
Switzerland									
Turkey									
Non-EU Total	3	2	1	1	1	3	2	2	2
%	**60%**	**67%**	**33%**	**33%**	**33%**	**100%**	**67%**	**67%**	**67%**
Total answers	18	17	15	14	13	18	16	15	14
Answers as % of total	**56%**	**94%**	**83%**	**78%**	**72%**	**100%**	**89%**	**83%**	**78%**

Q9. Do you use projected or concurrent adjustment?			
Country	**Answer**	**Projected adjustment**	**Concurrent adjustment**
Austria	1		×
Belgium			
Denmark	1		×
Finland	2		×
France	7	×	×
Germany	2	×	×
Greece	1		×
Ireland	1	×	×
Italy	2		×
Luxembourg	1	×	
Netherlands	1		×
Portugal	2	×	
Spain	2	×	×
Sweden	1		×
United Kingdom	1	×	×
EU-15 Total	14	7	12
%	**93%**	**50%**	**86%**
Bulgaria	1	×	
Cyprus			
Czech Republic	1		×
Estonia	1	×	×
Hungary	1		×
Latvia	1	×	
Lithuania	1	×	
Malta	1		×
Poland	1		×
Romania	1		×
Slovak Republic	8	×	×
Slovenia	1		×
NMS-12 Total	11	5	8
%	**92%**	**45%**	**73%**
Croatia	1		×
Iceland	1	×	
Norway	1		×
Switzerland			
Turkey	1	×	
Non-EU Total	4	2	2
%	**80%**	**50%**	**50%**
Total answers	18	9	14
Answers as % of total	**56%**	**50%**	**78%**

Q10. How often do you update the models and parameters in the SA procedure?														
Country	**Ans**	**Model**				**Parameter**				**Other Update I**				
		New observations appendeded	Once a year	Other periodicity (in month)	Other Comments	New observations appended	Once a year	Other periodicity (in month)	Other Comments	What	New observations appendeded	Once a year	Other periodicity (in month)	Other Comments
Austria	2		×			×								
Belgium														
Denmark	1	×	×			×	×							
Finland[1]	3		×	6	×	×								
France	7		×				×							
Germany[2]	2		×		×	×	×							
Greece	1	×				×								
Ireland	1	×	×			×	×							
Italy	2		×			×								
Luxembourg	1		×			×	×		×					
Netherlands	1	×	×			×	×							
Portugal	2			60		×	×							
Spain	2		×	60		×	×							
Sweden	1		×			×								
U.K.[1]	1		×		×		×		×					
EU-15 Total	14	4	12	3	3	12	9	0	2	0	0	0	0	0
%	**93%**	**29%**	**86**	**21%**	**21**	**86%**	**64**	**0%**	**14**	**0%**	**0%**	**0%**	**0%**	**0**
Bulgaria[1]	2		×		×		×		×					
Cyprus	1	×				×	×	×						
Czech Rep.	2		×		×	×	×	3						
Estonia[1]	1		×		×		×		×					
Hungary[1]	1		×		×		×		×	regressor		×		×
Latvia[3]	1		×		×		×		×					
Lithuania[1]	1		×				×		×					
Malta	1	×				×								
Poland	1		×				×							
Romania	1		×				×							
Slovak Rep.	9	×	×			×	×							
Slovenia	1		×			×								
NMS-12 Total	12	3	10	0	5	5	10	2	5	1	0	1	0	1
%	**100%**	**25%**	**83**	**0%**	**42**	**42%**	**83**	**17%**	**42**	**8%**	**0%**	**8%**	**0%**	**8**
Croatia[1]	2		×		×	×								
Iceland[3]	1	×			×	×			×					
Norway	1	×				×								
Switzerland	1		×	6		×								
Turkey[3]	1		×		×		×		×					
Non-EU Total	5	2	3	1	3	4	1	0	2	0	0	0	0	0
%	**100%**	**40%**	**60**	**20%**	**60**	**80%**	**20**	**0%**	**40**	**0%**	**0%**	**0%**	**0%**	**0**
Total answers	31	9	25	4	11	21	20	2	9	1	0	1	0	1
Answers as % of total	**97%**	**29%**	**81 %**	**13%**	**35 %**	**68%**	**65 %**	**6%**	**29 %**	**3%**	**0%**	**3%**	**0%**	**3 %**

[1] May be more frequent if a specific problem arises.
[2] Not necessary because of the series-independent approch of BV4.1
[3] Complete methodology still in process

Q11. For how many of your series do you aggregate with the following methods?

Country	Ans	Direct						Indirect					
		All	>75%	50-75%	25-50%	<25%	None	All	>75%	50-75%	25-50%	<25%	None
Austria	2	×	×									×	×
Belgium													
Denmark	1				×					×			
Finland	3	×	×									×	×
France	7	×			×	×	×	×	×	×			×
Germany	2	×			×					×			×
Greece	1			×								×	
Ireland	1				×					×			
Italy	2		×				×	×				×	
Luxembourg	1			×							×		
Netherlands	1		×							×		×	
Portugal	2	×						×					
Spain	2	×				×			×				×
Sweden	1		×									×	
United Kingdom	1				×					×			
EU-15 Total	14	6	5	2	5	2	2	3	2	6	1	6	5
%	**93%**	**43%**	**36%**	**14%**	**36%**	**14%**	**14%**	**21%**	**14%**	**43%**	**7%**	**43%**	**36%**
Bulgaria	2	×											×
Cyprus	1							×					
Czech Rep.	2		×						×			×	
Estonia	1	×											×
Hungary	1		×									×	
Latvia	1				×					×			
Lithuania	1		×									×	
Malta	1		×									×	
Poland	1	×											×
Romania	1	×											×
Slovak Rep.	9	×	×	×							×	×	×
Slovenia	1	×											×
NMS-12 Total	12	6	5	1	1	0	0	1	1	1	1	5	6
%	**100%**	**50%**	**42%**	**8%**	**8%**	**0%**	**0%**	**8%**	**8%**	**8%**	**8%**	**42%**	**50%**
Croatia	1						×	×					
Iceland	1	×											×
Norway	1					×			×				
Switzerland	1	×											×
Turkey	1	×											×
Non-EU Total	5	3	0	0	0	1	1	1	1	0	0	0	3
%	**100%**	**60%**	**0%**	**0%**	**0%**	**20%**	**20%**	**20%**	**20%**	**0%**	**0%**	**0%**	**60%**
Total answers	31	15	10	3	6	3	3	5	4	7	2	11	14
Answers as % of total	**97%**	**48%**	**32%**	**10%**	**19%**	**10%**	**10%**	**16%**	**13%**	**23%**	**6%**	**35%**	**45%**

Q11. For how many of your series do you aggregate with the following methods?

Country	Ans	Direct/ Indirect					
		100% / 0%	75-100% / 0-25%	50-75% / 25-50%	50% / 50%	25-50% / 50-75%	0% / 100%
Austria	2		×				
Belgium							
Denmark	1					×	
Finland	3		×				
France	7			×			
Germany	2			×			
Greece	1			×			
Ireland	1					×	
Italy	2					×	
Luxembourg	1			×			
Netherlands	1		×				
Portugal	2				×		
Spain	2			×			
Sweden	1		×				
U. K.	1					×	
EU-15 Total	14	0	4	5	1	4	0
%	**93%**	**0%**	**29%**	**36%**	**7%**	**29%**	**0%**
Bulgaria	2	×					
Cyprus	1						×
Czech Rep.	2				×		
Estonia	1	×					
Hungary	1		×				
Latvia	1				×		
Lithuania	1		×				
Malta	1		×				
Poland	1	×					
Romania	1	×					
Slovak Rep.	9		×				
Slovenia	1	×					
NMS-12 Total	**12**	**5**	**4**	**0**	**2**	**0**	**1**
%	**100%**	**42%**	**33%**	**0%**	**17%**	**0%**	**8%**
Croatia	1						×
Iceland	1	×					
Norway	1					×	
Switzerland	1	×					
Turkey	1	×					
Non-EU Total	5	3	0	0	0	1	1
%	**100%**	**60%**	**0%**	**0%**	**0%**	**20%**	**20%**
Total answers	31	8	8	5	3	5	2
Answers as % of total	**97%**	**26%**	**26%**	**16%**	**10%**	**16%**	**6%**
		21			3	7	
		68%			**10%**	**23%**	

Q12. What is the main practice in the transformation of the data?						
Country	**Answer**	**Test for log-transformation**	**In most cases logarithm**	**None**	**In most cases other transformation**	**Comments**
Austria	2	×				
Belgium						
Denmark	1	×	×			
Finland	3	×				
France	7	×	×	×		
Germany[1]	2	×	×	×		×
Greece	1	×				
Ireland	1		×			
Italy	2	×				
Luxembourg	1	×				
Netherlands	1	×				
Portugal	2	×				
Spain	2	×	×			
Sweden	1	×				
United Kingdom[2]	1	×				×
EU-15 Total	14	13	5	2	0	2
%	**93%**	**93%**	**36%**	**14%**	**0%**	**14%**
Bulgaria	2	×				
Cyprus	1	×				
Czech Republic	2	×	×			
Estonia	1	×				
Hungary	1	×				
Latvia	1		×			
Lithuania	1	×				
Malta	1		×			
Poland	1	×				
Romania	1	×				
Slovak Republic	9	×				
Slovenia	1	×				
NMS-12 Total	12	10	3	0	0	0
%	**100%**	**83%**	**25%**	**0%**	**0%**	**0%**
Croatia	3	×		×		
Iceland	1	×				
Norway	1		×			
Switzerland	1		×			
Turkey	1	×				
Non-EU Total	5	3	2	1	0	0
%	**100%**	**60%**	**40%**	**20%**	**0%**	**0%**
Total answers	31	26	10	3	0	2
Answers as % of total	**97%**	**84%**	**32%**	**10%**	**0%**	**6%**

[1] Not necessary because of the capacity of BV4.1 to tackle with changing sesonalities.
[2] Also use graph and information about series to determine whether transofrmation is needed.

Q13. Which regressors do you take in consideration?																										
		Trading day (TD)			Trading day (TD) & Specific holidays			Working day (WD)			Working day (WD) & specific holidays				Leap-year (LY)				Easter (EE)				Other			
Country	Ans	Test and consider	Consider independent from the t-value	Isn't in consideration	Test and consider	Consider independent from the t-value	Isn't in consideration	Test and consider	Consider independent from the t-value	Isn't in consideration	Test and consider	Consider independent from the t-value	Isn't in consideration	Comments	Test and consider	Consider independent from the t-value	Isn't in consideration	Comments	Test and consider	Consider independent from the t-value	Isn't in consideration	Comments	Regressor	Test and consider	Consider independent from the t-value	Isn't in consideration
Austria[1]	2										×				×		×	×	×							
Belgium																										
Denmark	1	×	×	×	×		×	×		×	×		×		×		×		×	×	×			×		×
Finland	3	×		×	×		×	×		×	×		×		×		×		×		×					
France	7	×	×	×	×	×	×	×	×	×	×		×		×	×	×		×	×	×		French calendar	×		
Germany[2]	2				×	×					×			×	×				×				AO, LS	×		
Greece	1	×			×			×			×				×				×							
Ireland	1	×		×			×			×			×				×				×					
Italy[3]	2	×	×	×	×					×	×			×	×			×	×			×				
Luxembourg	1										×				×				×							
Netherlands	1				×										×				×				Staggered holidays	×		
Portugal	2	×						×	×		×	×			×				×	×						
Spain	2	×									×				×				×							
Sweden	1	×			×			×											×							
U.K.	1	×			×					×			×		×				×							
EU-15 Total	14	10	3	5	9	2	4	6	2	6	10	1	5	2	12	1	5	2	13	3	4	1	3	4	0	1
%	93%	71%	21%	36%	64%	14%	29%	43%	14%	43%	71%	7%	36%	14	86	7%	36%	14%	93%	21%	29%	7%	21%	29%	0%	7%
Bulgaria	2										×				×											
Cyprus	1				×	×					×	×			×		×		×		×					
Czech Rep.	2	×		×	×		×	×		×	×	×			×		×		×		×					×
Estonia	1				×						×				×				×							
Hungary	1				×						×				×				×							
Latvia	1				×						×				×				×							
Lithuania	1	×			×			×			×				×				×							
Malta	1																		×				specific holidays	×		
Poland	1	×			×			×			×				×				×							
Romania	1	×	×					×	×						×	×			×	×						
Slovak Rep.	7	×	×		×	×		×	×		×	×			×	×			×	×						
Slovenia	1	×			×			×			×				×				×							
NMS-12 Total	12	6	2	1	9	2	1	6	2	1	10	3	0	0	11	2	2	0	11	2	2	0	1	1	0	1
%	100	50%	17%	8%	75%	17%	8%	50%	17%	8%	83%	25%	0%	0%	92	17%	17%	0%	92%	17%	17%	0%	8%	8%	0%	8%
Croatia	3	×			×			×			×				×				×							
Iceland	1				×						×				×				×							
Norway	1	×						×											×							
Switzerland	1							×	×																	
Turkey	1										×															
Non-EU Total	5	2	0	0	2	0	0	3	1	0	3	0	0	0	2	0	0	0	3	0	0	0	0	0	0	0
%	100	40%	0%	0%	40%	0%	0%	60%	20%	0%	60%	0%	0%	0%	40	0%	0%	0%	60%	0%	0%	0%	0%	0%	0%	0%
Total answers	31	18	5	6	20	4	5	15	5	7	23	4	5	2	25	3	7	2	27	5	6	1	4	5	0	2
Answers as % of total	97%	58%	16%	19%	65%	13%	16%	48%	16%	23%	74%	13%	16%	6%	81	10%	23%	6%	87%	16%	19%	3%	13%	16%	0%	6%

[1] Series too short.
[2] Where relevant.
[3] The sign of the coefficient is considered.

Q14. Did it occur that the t-value of the LY was significant and the WD/TD wasn't? How did you solve the problem?						
Country	**Answer**	**Yes**	**Solution**	**No, never**	**Other special problem**	**Solution**
Austria	1	×	×			
Belgium						
Denmark	1			×		
Finland						
France	3			×		
Germany	1			×		
Greece	1			×		
Ireland						
Italy	2			×	×[1]	×[2]
Luxembourg	1			×		
Netherlands	1	×	×[3]			
Portugal	2	×	×[4]	×		
Spain	2			×		
Sweden	1			×		
United Kingdom	1			×		
EU-15 Total	12	3	3	10	1	1
%	**80%**	**25%**	**25%**	**83%**	**8%**	**8%**
Bulgaria						
Cyprus						
Czech Republic	2			×		
Estonia	1	×				
Hungary	1	×	×[3]			
Latvia						
Lithuania	1	×	×[5]			
Malta						
Poland	1	×	×[5]			
Romania	1			×		
Slovak Republic	8			×		
Slovenia	1			×		
NMS-12 Total	8	4	3	4	0	0
%	**67%**	**50%**	**38%**	**50%**	**0%**	**0%**
Croatia	3			×		
Iceland	1			×		
Norway						
Switzerland						
Turkey						
Non-EU Total	2	0	0	2	0	0
%	**40%**	**0%**	**0%**	**100%**	**0%**	**0%**
Total answers	22	7	6	16	1	1
Answers as % of total	**69%**	**32%**	**27%**	**73%**	**5%**	**5%**

[1] It might happen that the estimated value of the regression coefficient for LY is sensible higher than that for WD/TD, causing a large adjustment to the first quarter of the leap year.
[2] Keep under control the relative size of the regression coefficient for LY.
[3] Only LY adjustment.
[4] No corrections are made.
[5] LY and WD together.

Q15. Which types of outliers are taken in consideration?					
Country	**Answer**	**Additive outlier**	**Temporary change**	**Level shift**	**Others**
Austria	2	×	×	×	
Belgium					
Denmark	1	×	×	×	
Finland	3	×	×	×	
France	3	×	×	×	
Germany	2	×	×	×	
Greece	1	×			
Ireland	1	×	×		
Italy	2	×	×	×	
Luxembourg	1	×	×	×	
Netherlands	1	×	×	×	
Portugal	2	×	×	×	None[1]
Spain	2	×	×	×	
Sweden	1	×	×	×	
United Kingdom	1	×		×	
EU-15 Total	14	14	12	12	1
%	**93%**	**100%**	**86%**	**86%**	**7%**
Bulgaria	1	×	×	×	
Cyprus	1	×	×		
Czech Republic	2	×	×	×	
Estonia	1	×	×	×	
Hungary	1	×	×	×	
Latvia	1	×	×	×	
Lithuania	1	×	×	×	
Malta	1	×	×	×	
Poland	1	×	×	×	
Romania	1	×	×	×	
Slovak Republic	9	×	×	×	
Slovenia	1	×	×	×	
NMS-12 Total	12	12	12	11	0
%	**100%**	**100%**	**100%**	**92%**	**0%**
Croatia	3	×	×	×	
Iceland	1			×	
Norway	1	×		×	
Switzerland	1	×		×	
Turkey	1	×	×	×	
Non-EU Total	5	4	2	5	0
%	**100%**	**80%**	**40%**	**100%**	**0%**
Total answers	31	30	26	28	1
Answers as % of total	**97%**	**97%**	**84%**	**90%**	**3%**

[1] In special cases.

Q16. How do you detect these types of outliers?						
Country	**Answer**	**Always by test**	**In most cases by test**	**In most cases experts define**	**Only experts define**	**Other**
Austria	2	×	×			
Belgium						
Denmark	1		×			
Finland	2		×	×		
France	3	×	×			×[1]
Germany	2		×			
Greece	1	×				
Ireland	1	×				
Italy	1	×	×			
Luxembourg	1		×			
Netherlands	1					×[1]
Portugal	2	×	×			
Spain	2	×				
Sweden	1	×				
United Kingdom	1		×			×[1]
EU-15 Total	14	8	9	1	0	3
%	**93%**	**57%**	**64%**	**7%**	**0%**	**21%**
Bulgaria	1	×				
Cyprus	1		×			
Czech Republic	2		×	×		
Estonia	1	×				
Hungary	1		×			
Latvia	1	×				
Lithuania	1		×	×		
Malta	1	×				
Poland	1		×			
Romania	1	×				
Slovak Republic	9	×	×			
Slovenia	1		×			
NMS-12 Total	12	6	7	2	0	0
%	**100%**	**50%**	**58%**	**17%**	**0%**	**0%**
Croatia	3	×				
Iceland	1		×			
Norway	1		×			
Switzerland	1	×				
Turkey	1		×			
EU Total	5	2	3	0	0	0
%	**100%**	**40%**	**60%**	**0%**	**0%**	**0%**
Total answers	31	16	19	3	0	3
Answers as % of total	**97%**	**52%**	**61%**	**10%**	**0%**	**10%**

Q17. What do the experts validate during the seasonal adjusting process?							
Country	**Ans**	**Outliers**	**Type of transformation**	**Regressors**	**Result**	**Nothing**	**Others**
Austria	2	×		×	×	×	
Belgium							
Denmark	1				×		
Finland	3	×		×	×		Model, correlation in the residuals,
France	7	×	×	×	×		Presence of
Germany	2	×	×	×	×		
Greece	1	×	×	×	×		
Ireland	1				×		
Italy	2	×			×		
Luxembourg	1	×	×	×	×		
Netherlands	1	×	×	×	×		Seasonal adjustment, filters used
Portugal	2	×	×	×	×		
Spain	2	×	×	×	×		
Sweden	1	×	×	×	×		
United Kingdom	1	×	×	×	×		
EU-15 Total	14	12	9	11	14	1	3
%	**93%**	**86%**	**64%**	**79%**	**100%**	**7%**	**21%**
Bulgaria	2	×		×	×		
Cyprus	1	×	×	×			
Czech Republic	1	×		×			
Estonia	1					×	
Hungary	1	×		×	×		
Latvia	1		×	×	×		
Lithuania	1	×	×	×	×		Model and it's parameters significance
Malta	1				×		
Poland	1	×	×	×	×		
Romania	1	×	×	×	×		
Slovak Republic	9	×		×	×		
Slovenia	1	×		×			
NMS-12 Total	12	9	5	10	8	1	1
%	**100%**	**75%**	**42%**	**83%**	**67%**	**8%**	**8%**
Croatia	3		×	×	×		
Iceland							
Norway	1				×		
Switzerland	1	×		×	×		
Turkey							
Non-EU Total	3	1	1	2	3	0	0
%	**60%**	**33%**	**33%**	**67%**	**100%**	**0%**	**0%**
Total answers	29	22	15	23	25	2	4
Answers as % of total	**91%**	**76%**	**52%**	**79%**	**86%**	**7%**	**14%**

[1] Mixed by test and data experts.

Q18. What do you apply the seasonal adjusted time series to?					
Country	**Answer**	**To publication**	**To imputation**	**To validation**	**To forecasts**
Austria	2	×		×	×
Belgium					
Denmark	1	×			
Finland	3	×			
France	7	×	×		×
Germany	2	×		×	
Greece	1			×	×
Ireland	1	×			
Italy	1	×			
Luxembourg	1	×	×		×
Netherlands	1	×			
Portugal	2	×	×	×	×
Spain	2	×			
Sweden	1	×		×	×
United Kingdom	1	×	×		×
EU-15 Total	14	13	4	5	7
%	**93%**	**93%**	**29%**	**36%**	**50%**
Bulgaria	2	×		×	
Cyprus	1	×	×		×
Czech Republic	2	×			×
Estonia	1	×			×
Hungary	1	×			
Latvia	1	×			×
Lithuania	1	×	×	×	×
Malta	1	×			
Poland	1	×			
Romania	1	×			×
Slovak Republic	9	×		×	×
Slovenia	1	×			×
NMS-12 Total	12	12	2	3	8
%	**100%**	**100%**	**17%**	**25%**	**67%**
Croatia	3	×			
Iceland	1	×			
Norway	1	×		×	×
Switzerland	1	×			
Turkey	1	×			×
Non-EU Total	5	5	0	1	2
%	**100%**	**100%**	**0%**	**20%**	**40%**
Total answers	31	30	6	9	17
Answers as % of total	**97%**	**97%**	**19%**	**29%**	**55%**

Q19. What type of data do you publish?						
Country	**Answer**	**Raw data**	**SA data**	**Trend**	**Working-day adjusted data**	**Others**
Austria	2	×	×	×	×	
Belgium						
Denmark	1	×	×		×	
Finland	3	×	×	×	×	
France	7	×	×		×	
Germany	2	×	×	×	×	Residual component
Greece	1	×			×	
Ireland	1	×	×		×[1]	
Italy	2	×	×		×	
Luxembourg	1	×	×		×	
Netherlands	1	×	×		×	
Portugal	2	×	×		×	
Spain	2	×	×		×	
Sweden	1	×	×	×	×	
United Kingdom	1	×	×	×[1]		
EU-15 Total	14	14	13	5	13	1
%	**93%**	**100%**	**93%**	**36%**	**93%**	**7%**
Bulgaria	1	×	×	×		
Cyprus	1	×	×	×	×	
Czech Republic	2	×	×	×	×	
Estonia	1	×	×	×	×	
Hungary	1	×	×	×[2]	×[1]	
Latvia	1	×	×		×	
Lithuania	1	×	×	×	×	
Malta	1	×	×	×		
Poland	1	×	×	×	×	
Romania	1	×	×		×	
Slovak Republic	9	×	×	×	×	
Slovenia	1	×	×	×	×	
NMS-12 Total	12	12	12	10	10	0
%	**100%**	**100%**	**100%**	**83%**	**83%**	**0%**
Croatia	2	×	×	×	×	
Iceland	1	×	×			
Norway	1	×	×			
Switzerland	1	×	×			
Turkey	1	×	×			
Non-EU Total	5	5	5	1	1	0
%	**100%**	**100%**	**100%**	**20%**	**20%**	**0%**
Total answers	31	31	30	16	24	1
Answers as % of total	**97%**	**100%**	**97%**	**52%**	**77%**	**3%**

[1] In special case.
[2] In graphs.

Q20. What type of metainformation do you publish?																					
Country	Ans	Method(s) used				Parameters used in the SA				Working/trading day adjustment applied				Documentation about events explaining outliers				Other			
		For internal	For external	For Eurostat	Comments	For internal	For external	For Eurostat	Comments	For internal	For external	For Eurostat	Comments	For internal	For external	For Eurostat	Comments	For internal	For external	For Eurostat	Comments
Austria	2	×	×	×		×				×	×			×							
Belgium	-																				
Denmark	1	×	×	×						×	×	×		×	×	×					
Finland	3	×	×	×		×				×	×										
France	6	×	×	×		×				×	×	×		×							
Germany	2	×	×	×		×	×	×	×[1]	×	×	×	×[1]								
Greece	1	×	×	×				×		×	×	×		×		×					
Ireland	1	×	×							×		×									
Italy	2	×	×	×		×	×			×	×	×							×[2]		×[2]
Luxembourg	1	×	×																		
Netherlands	1	×	×	×		×	×	×		×	×	×									
Portugal	2	×	×		×[1]					×			×[3]								
Spain	2	×	×	×						×				×							
Sweden	1	×	×							×	×										
United Kingdom	1	×	×	×	×[4]	×			×[4]	×				×							×[5]
EU-15 Total	**14**	**14**	**14**	**10**	**2**	**7**	**3**	**3**	**2**	**13**	**9**	**7**	**2**	**6**	**1**	**2**	**0**	**0**	**1**	**0**	**2**
Bulgaria	0																				
Cyprus	0																				
Czech Rep.	2	×	×	×		×	×	×		×	×	×		×	×						
Estonia	1			×	×[6]			×	×[6]			×	×[6]								
Hungary	1	×	×			×	×														
Latvia	1			×						×		×									
Lithuania	1	×	×	×		×	×	×		×	×	×		×	×	×					
Malta	1					×															
Poland	1	×	×	×																	
Romania	1	×	×	×		×		×		×	×	×									
Slovak Rep.	9	×	×	×		×		×		×		×									
Slovenia	1	×	×							×	×										
NMS-12 Total	**10**	**7**	**7**	**7**	**1**	**6**	**3**	**5**	**1**	**6**	**4**	**6**	**1**	**2**	**2**	**1**	**0**	**0**	**0**	**0**	**0**
Croatia	3	×	×	×		×				×		×						×[7]			
Iceland	0																				
Norway	1	×	×	×		×				×											
Switzerland	1	×	×		×[8]	×			×[8]												
Turkey	0																				
Non-EU Total	**3**	**3**	**3**	**2**	**1**	**3**	**0**	**0**	**1**	**2**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**
Total answers	**27**	**24**	**24**	**19**	**4**	**16**	**6**	**8**	**4**	**21**	**13**	**14**	**3**	**8**	**3**	**3**	**0**	**1**	**1**	**0**	**2**
Answers as % of	**84%**	**92%**	**92%**	**73%**	**15%**	**89%**	**33%**	**44%**	**22%**	**100%**	**62%**	**67%**	**14%**	**100%**	**38%**	**38%**	**0%**	**4%**	**4%**	**0%**	**7%**
Total answers by		**26**				**18**				**21**				**8**				**3**			
%		**96%**				**67%**				**78%**				**30%**				**11%**			

[1] On request.
[2] Reg-ARIMA models; only for industrial production indices.
[3] WDA series are not published in national data yet.
[4] All metainformation is available to Eurostat on request. The publication of other metainformation for external usage is currently being reviewed.
[5] Publication of quality measures is being condsidered.
[6] Once a year, only for data of wage statistics.
[7] Basic description of raw data; methodological notes in publications.
[8] Only by employment, production statistics on demand.

Q21. On which media do you disseminate the data?							
Country	**Answer**	**Paper publications**	**Internet publications**	**CD-ROMs**	**Reference databases**	**Ad hoc users' queries**	**Other**
Austria	2	×	×	×	×	×	
Belgium							
Denmark	1	×	×	×	×		
Finland	3	×	×		×	×	
France	7	×	×		×		
Germany	2	×	×	×	×	×	
Greece	1	×	×	×	×	×	
Ireland	1	×	×			×	
Italy	2	×	×		×		
Luxembourg	1	×			×	×	
Netherlands	1	×	×		×		
Portugal	2		×				×
Spain	2	×	×		×		
Sweden	1	×	×		×		
United Kingdom	1	×	×			×	
EU-15 Total	14	13	13	4	11	7	1
%	**93%**	**93%**	**93%**	**29%**	**79%**	**50%**	**7%**
Bulgaria	2	×	×				×
Cyprus	1	×	×				
Czech Republic	2	×	×		×		
Estonia	1	×	×				×
Hungary	1	×	×		×	×	
Latvia	1	×	×				
Lithuania	1	×	×	×	×	×	
Malta	1	×	×				
Poland	1	×	×		×		
Romania	1	×			×		
Slovak Republic	9	×	×	×	×	×	×
Slovenia	1	×	×		×		
NMS-12 Total	12	12	11	2	7	3	3
%	**100%**	**100%**	**92%**	**17%**	**58%**	**25%**	**25%**
Croatia	3	×	×		×	×	
Iceland	1	×	×		×		
Norway	1	×	×		×		
Switzerland	1	×	×			×	
Turkey	1	×	×	×	×		
Non-EU Total	5	5	5	1	4	2	0
%	**100%**	**100%**	**100%**	**20%**	**80%**	**40%**	**0%**
Total answers	31	30	29	7	22	12	4
Answers as % of total	**97%**	**97%**	**94%**	**23%**	**71%**	**39%**	**13%**

Q22. Please specify some problem with its solution in connection with seasonal adjustment!?	
Country	
Austria	**Statistics Austria** noted as a problem the case when there was seasonality in Reg-ARIMA Residual. The solution is to try different ARIMA-Model, accept additional outliers. Other problem is that instable trading day regressors come up because of the short series. The solution for this is using only one trading day regressor. **Austrian Institute of Economic Research (WIFO)** noted that there is a lack of additivity in using the direct method; they use instead of this the Multivariate Denton procedure.Recently margin values were submitted to great revisions. The solution for that is making stability checks with indirect methods' results.
France	**INSEE** has some problem with missing values and indicator volatility. Concerning missing value the solution is interpolation and concerning indicator volatility the publication together raw data.
Ireland	They want to move from fixed-factor to concurrent adjustment and will introduce the minimum seasonal adjustment standards in CSO by the beginning of 2007, including a recommendation to adjust concurrently.
Italy	ISTAT noted that it is very important to manage accurately the identification and estimation of outliers. Different outliers in subsequent estimation might provide very different seasonal adjusted series. The solution was in the latest revision of quarterly national accounts in March that they introduced a modification in their SA procedure in order to avoid such revisions. They identify outliers once a year, contemporaneously with the identification of the ARIMA model. Then, during the year, Statistics Italy keeps the identified outliers fixed; for the new observations they verify on the residual series the existence of possible new outliers.
Netherlands	They had some problem first with the differences between seasonal adjusted series and original year totals, second between trading-day adjusted series and original year totals. The solution is that they optimize the user-defined regressors if used.
Spain	1. The series with level-transformation were adjusted by subtracting the adjustment value to the original series. This level transformation caused changes in adjusted rates due to the transformation and not because of the adjustment. Solution: Every series are Log-transformed. 2. There were series where there was no significant t-value for any regressors. Solution: Sometimes, increasing the time span of data has solved this problem. In other cases, (for example in series 5261- Retail Trade made by mail - and deflated 5261), it's not possible to find a significant regressor based on working days , so these series are not adjusted at all. 3. With the recent change in data links due to the base year change, Level shift outlier effect disappeared in those years where it should have been involved and an unreal effect appeared in the years before the outlier. This was the case because the data links were divided by the outlier value, so when we used them to link with the previous base data, those months with level shift were multiplied and divided by the same value and those without level shift were divided by the outlier value. Moreover this kind of outliers tends to die out as the number of data increases. Solution: Level Shift Outliers had been excluded in our last adjustment.
Sweden	1. The model based ARIMA-approach is highly sensitive to the choice of the ARIMA-model. Different models produced highly different dynamics of the SA series. Solution: An accepted quality measure of SA would be of great value. Measures of uncertainty in SA should be calculated e.g. std (seasonally adjusted series) in the 'model-space'. Perhaps SA with structural time series models (STM) is more robust. 2. The costs for maintenance of SA in terms of yearly revisions are large partly caused by revisions of the original series (e.g. benchmarking).Solution: 2.1. The SA procedures should be more stable. The issue of 'robustness in SA' may be introduced as a quality of procedures. 2.2. The impact on revision demand caused by benchmarking should be investigated. 2.3. The STM-approach for SA should have more attention and has to be investigated.
United Kingdom	There is a problem if a TD effect on quarterly data is insignificant. They don't use any adjustment for trading day.The problem is if working-day adjusted series should be produced. In the UK, public holidays are unchanged from year to year so impact is not important. Therefore it is a question if WD adjustment should be regarded as an integrated part of SA process.
Croatia	They were having difficulties with working/trading day adjustment therefore they used this capability of TRAMO/SEATS in Demetra.
Norway	They had some problem with Easter and Trading-day effect therefore they used user-defined variables.

Q23/a. What measures do you use in the graphical inspections?

Country	Ans	Relevance	Mean and standard deviation of the raw and SA series	Standard deviation relative to trend	MCD/QCD statistics	Intuitively on face of fit	Other
Austria	1	2,0				×	×
Belgium							
Denmark	1	5,0				×	
Finland	3	5,0	×			×	
France	7	4,6	×	×		×	
Germany	2	5,0				×	×[1]
Greece	1	5,0	×	×			
Ireland	1	3,0				×	
Italy	2	4,5	×				×[2]
Luxemburg	1	5,0	×	×			
Netherlands	1	5,0			×	×	×[3]
Portugal	2	3,0	×	×		×	
Spain	2	5,0	×	×		×	
Sweden	1	5,0				×	×[4]
United Kingdom	1	5,0			×	×	
EU-15 Total	14	4,4	7	5	2	11	5
%	**93%**		**50%**	**36%**	**14%**	**79%**	**36%**
Bulgaria	2	5,0		×		×	
Cyprus	1	2,0		×			
Czech Republic	2	3,5				×	
Estonia	1		×				
Hungary	1	4,0				×	
Latvia							
Lithuania	1	4,0	×	×	×	×	
Malta	1	4,0				×	
Poland	1	4,0	×	×		×	
Romania	1	3,0	×			×	
Slovak Republic	6	4,5	×			×	
Slovenia	1	5,0		×		×	
NMS-12 Total	11	3,9	5	5	1	9	0
%	**92%**		**45%**	**45%**	**9%**	**82%**	**0%**
Croatia	3	3,7		×			
Iceland	1	4,0	×			×	
Norway	1	4,0	×	×			
Switzerland	1	5,0		×	×		×[5]
Turkey	1	4,0	×				
Non-EU Total	5	4,1	3	3	1	1	1
%	**100%**		**60%**	**60%**	**20%**	**20%**	**20%**
Total answers	30	4,2	15	13	4	21	6
Answers as % of total	**94%**		**50%**	**43%**	**13%**	**70%**	**20%**

[1] Raw and final seasonal factors.
[2] Month-to-month variations on SA series expecially in the last two/three years. Spectral peaks at seasonal and working-day frequencies.
[3] Expert judgement.
[4] Graphical inspection (GI) is used to the SA and trend-series and their changes riased to a yearly level. GI is on residuals and eventually for spectrum for residuals.
[5] Spectral peaks.

Q23/b. What do you examine in terms of the autocorrelation pattern?

Country	Answer	Relevance	The significant peaks of the autocorrelogram	Box-Pierce statistics for seasonality	F-test for seasonality	Other
Austria	2	4,0		×	×	
Belgium						
Denmark	1	2,0	×			
Finland	3	2,5	×	×		
France	7	2,8	×		×	×
Germany	2	2,5	×		×	×[1]
Greece	1	5,0	×	×	×	
Ireland	1	2,0			×	
Italy	2	3,5	×	×		
Luxemburg	1	4,0		×	×	
Netherlands	1	2,0			×	
Portugal	2	2,0	×	×	×	
Spain	2	3,5	×	×		
Sweden	1	0,0				
United Kingdom	1	2,0	×		×	
EU-15 Total	14	2,7	9	7	9	2
%	**93%**		**64%**	**50%**	**64%**	**14%**
Bulgaria	2	4,0	×			
Cyprus	1	1,0			×	
Czech Republic	2	4,0	×	×		
Estonia	1	0,0				
Hungary	1	2,0	×			
Latvia						
Lithuania	1	3,0	×	×	×	
Malta	1	0,0				
Poland	1	4,0	×	×		
Romania	1	4,0	×			
Slovak Republic	6	4,0		×		×
Slovenia	1	5,0	×	×		
NMS-12 Total	11	2,8	7	5	2	1
%	**92%**		**64%**	**45%**	**18%**	**9%**
Croatia	3	4,0	×	×	×	
Iceland	1	0,0				
Norway	1	3,0	×	×	×	
Switzerland	1	5,0	×		×	
Turkey	1	0,0				
Non-EU Total	5	2,4	3	2	3	0
%	**100%**		**60%**	**40%**	**60%**	**0%**
Total answers	30	2,7	19	14	14	3
Answers as % of total	**94%**		**63%**	**47%**	**47%**	**10%**

[1] ACF, PACF of the model residuals.

Q23/c. Which statistics on residual do you use for quality of ARIMA modelling?								
Country	**Answer**	Relevance	Ljung-Box Q-statistics	Ljung-Box Q-statistics for squared residuals	Box-Pierce Q-statistics	Box-Pierce Q-statistics for squared residual	Normality test	Other
Austria	2	5,0	×	×	×		×	
Belgium								
Denmark	1	4,0	×					
Finland	3	4,3	×	×	×	×	×	
France	7	3,3	×	×	×	×	×	
Germany	2	3,0	×	×	×	×	×	×
Greece	1	5,0	×	×	×	×	×	
Ireland	1	0,0						
Italy	2	4,5	×	×	×	×	×	×[1]
Luxemburg	1	4,0	×	×	×	×	×	
Netherlands	1	2,0		×				
Portugal	2	3,5	×		×	×		
Spain	2	4,5	×	×	×		×	
Sweden	1	5,0	×	×	×	×	×	×[2]
United Kingdom	1	4,0	×				×	
EU-15 Total	14	3,7	12	10	10	8	10	3
%	**93%**		**86%**	**71%**	**71%**	**57%**	**71%**	**21%**
Bulgaria	2	0,0						
Cyprus	1	1,0	×				×	
Czech Republic	2	5,0	×	×	×	×	×	
Estonia	1	4,0	×	×	×	×	×	
Hungary	1	5,0	×	×	×	×	×	
Latvia								
Lithuania	1	5,0	×	×	×	×	×	
Malta	1	5,0	×	×	×	×	×	
Poland	1	3,0	×	×	×	×	×	
Romania	1	5,0	×	×	×	×	×	
Slovak Republic	6	4,7	×	×	×	×	×	
Slovenia	1	5,0	×	×	×	×	×	
NMS-12 Total	11	3,9	10	9	9	9	10	0
%	**92%**		**91%**	**82%**	**82%**	**82%**	**91%**	**0%**
Croatia	3	3,3	×		×		×	
Iceland	1	5,0	×	×	×	×	×	
Norway	1	4,0	×		×		×	
Switzerland	1	5,0	×	×			×	
Turkey	1	4,0	×	×	×	×	×	
Non-EU Total	5	4,3	5	3	4	2	5	0
%	**100%**		**100%**	**60%**	**80%**	**40%**	**100%**	**0%**
Total answers	30	3,9	27	22	23	19	25	3
Answers as % of total	**94%**		**90%**	**73%**	**77%**	**63%**	**83%**	**10%**

[1] Statistical significativity of the mean, Standard deviation, Studentized residuals.
[2] Significance of the ARIMA-model; standard deviation of changes of the SA series; BIC; sign test on residuals; DW-test on the residuals.

Q23/d. What kind of fit statistics do you provide in your practice?						
Country	**Answer**	**Relevance**	**AIC**	**AICC**	**BIC**	**Other**
Austria	2	4,0	×	×	×	
Belgium						
Denmark	1	4,0	×	×		
Finland	3	5,0			×	
France	7	3,3	×		×	
Germany	2	3,0	×	×	×	
Greece	1	5,0	×		×	
Ireland	1	0,0				
Italy	2	3,0	×		×	
Luxemburg	1	4,0	×			
Netherlands	1	0,0				
Portugal	2	0,0				
Spain	2	5,0	×		×	
Sweden	1	2,0			×	
United Kingdom	1	4,0		×		
EU-15 Total	14	3,0	8	4	8	0
%	**93%**		**57%**	**29%**	**57%**	**0%**
Bulgaria	2	0,0				
Cyprus	1	1,0			×	
Czech Republic	2	4,0				×
Estonia	1	4,0	×			
Hungary	1	4,0	×		×	
Latvia						
Lithuania	1	5,0				×
Malta	1	0,0				
Poland	1	4,0	×		×	
Romania	1	4,0	×		×	
Slovak Republic	6	0,0				
Slovenia	1	3,0			×	
NMS-12 Total	11	2,6	4	0	5	2
%	**92%**		**36%**	**0%**	**45%**	**18%**
Croatia	3	3,0	×			
Iceland	1	0,0				
Norway	1	3,0	×	×	×	
Switzerland	1	5,0		×		
Turkey	1	4,0				×
Non-EU Total	5	3,0	2	2	1	1
%	**100%**		**40%**	**40%**	**20%**	**20%**
Total answers	30	2,9	14	6	14	3
Answers as % of total	**94%**		**47%**	**20%**	**47%**	**10%**

Q23/e. Do you examine the stability of the results over time?					
Country	Answer	Relevance	Every time	In special case	Never
Austria	2	3,0		×	×
Belgium					
Denmark	1	0,0			×
Finland	3	4,3	×	×[1]	
France	7	4,1	×[2]	×[3]	
Germany	2	2,5		×[4]	
Greece	1	5,0	×		
Ireland	1	3,0		×[5]	
Italy	2	4,5	×	×[6]	
Luxemburg	1	3,0		×	
Netherlands	1	5,0	×		
Portugal	2	3,0	×		
Spain	2	3,0		×[7]	
Sweden	1	4,0		×[8]	
United Kingdom	1	3,0		×[9]	
EU-15 Total	14	3,4	6	10	2
%	**93%**		**43%**	**71%**	**14%**
Bulgaria	2	5,0	×		×
Cyprus	1	1,0		×	
Czech Republic	2	2,0		×[10]	
Estonia	1	3,0	×		
Hungary	1	2,0		×	
Latvia					
Lithuania	1	5,0	×		
Malta	1	0,0			×
Poland	1	4,0	×		
Romania	1	0,0			×
Slovak Republic	6	4,2	×		
Slovenia	1	5,0	×		
NMS-12 Total	11	2,8	6	3	3
%	**92%**		**55%**	**27%**	**27%**
Croatia	3	4,5		×[11]	×
Iceland	1	3,0		×[12]	
Norway	1	4,0		×[13]	
Switzerland	1	5,0			
Turkey	1	4,0		×[14]	
Non-EU Total	5	4,1	0	4	1
%	**100%**		**0%**	**80%**	**20%**
Total answers	30	3,3	12	17	6
Answers as % of total	**94%**		**40%**	**57%**	**20%**

1.When changing the model.
2. Moving seasonality test.
3. Once a year in a specific study.
4. Important time series and all national account series, For all trend components displayed in the internet
5. Only when business unit has concerns about the seasonally adjusted estimates.
6. The stability is examined once a year when models are updated. It concerns both model parameters and SA data (size of revisions)
7. Annual revision, Every year, when the reggressor values change.
8. At least once a year and for the most important series every time.
9. Where there have been changes that may have a large impact on a regressor e.g. when Easter/TD chnages for being significant to non-significnat or vice-versa.
10. If required by subject matter statisticians or users.
11. Large outliers.
12. It depends on how much the raw data has changed.
13. To check the results.
14.SA is being tested now.

Q24. Do you use a quality measure for the results?					
Country	**Answer**	**M-Statistics**	**SA quality index**	**No**	**Other**
Austria	2	×		×	
Belgium					
Denmark	1	×	×		
Finland	3		×	×	
France	7		×	×	
Germany	2	×			×[1]
Greece	1	×	×		
Ireland	1	×			
Italy	2			×	×[2]
Luxemburg	1			×	
Netherlands	1	×			
Portugal	2	×	×		
Spain	2			×	
Sweden	1				×[3]
United Kingdom	1	×			×[4]
EU-15 Total	14	8	5	6	4
%	**93%**	**57%**	**36%**	**43%**	**29%**
Bulgaria	2		×	×	
Cyprus	1	×			
Czech Republic	2		×	×	
Estonia	1	×	×		
Hungary	1		×		
Latvia					
Lithuania	1	×	×		
Malta	1			×	
Poland	1		×		
Romania	1		×		
Slovak Republic	6		×		
Slovenia	1		×		
NMS-12 Total	11	3	9	3	0
%	**92%**	**27%**	**82%**	**27%**	**0%**
Croatia	3	×	×		
Iceland	1	×	×		
Norway	1	×	×		
Switzerland	1	×			
Turkey	1		×		
Non-EU Total	5	4	4	0	0
%	**100%**	**80%**	**80%**	**0%**	**0%**
Total answers	30	15	18	9	4
Answers as % of total	**94%**	**50%**	**60%**	**30%**	**13%**

[1] Not relevant because of the series- und user-independent character of the BV4.1 approach.
[2] Mean, variance and MAPE of revisions in SA data.
[3] Some explorataive quality measures are under test.
[4] Some measures of quality are developed, which are being currently reviewed in relation to publication of metadata.

OECD survey in 2002 and HoSA suvey in 2006

We compared the answers given for the 2002 OECD questionnaire to the answers to HoSA questionnaire in 2006. Since not the same countries filled in the questionnaire, we examined only those countries which answered the question in both survey. In this case there were 16 countries.

Seasonal Adjustment methods used																
	OECD survey in 2002											HCSO survey in 2006				
Country	Ans	Currently used in 2002					Planned in 2002					Ans	Currently used in 2006			
		T/S	X11	X11-ARIMA	X12	Other	T/S	X11	X11 ARIMA	X12	Other		T/S	X11	X12	Other
Denmark	1			×						×		1	×		×	
Finland	1		×	×			×			×		3	×		×	
France	1			×						×		8	×	×	×	
Germany	1				×	BV4					×	1			×	BV4.1
Ireland	1		×							×		1		×		
Italy	1	×					×					2	×			
Luxembourg	1			×						×		1	×			
Netherlands	1		×		×		×				×	1			×	
Spain	1	×					×					2	×			
Sweden	1	×	×	×			×			×		1	×	×	×	
United Kingdom	1			×	×					×		1		×	×	
EU-15 Total	11	3	4	6	3	1	5	0	0	7	2	11	7	4	7	1
%		**27%**	**36%**	**55%**	**27%**	**9%**	**45%**	**0%**	**0%**	**64%**	**18%**		**64%**	**36%**	**64%**	**9%**
Czech Rep.	1	×			×	Dainties	×			×	×	2	×		×	Dainties
Poland	2			×			×					1	×			
Slovak Rep.	5	×				×	×				×	9	×			
NMS-12 Total	3	2	0	1	1	2	3	0	0	1	2	3	3	0	1	1
%		**67%**	**0%**	**33%**	**33%**	**67%**	**100%**	**0%**	**0%**	**33%**	**67%**		**100%**	**0%**	**33%**	**33%**
Norway	1				×					×		1			×	
Switzerland	1				×					Test		1			×	
Non-EU Total	2	0	0	0	2	0	0	0	0	2	0	2	0	0	2	0
%		**0%**	**0%**	**0%**	**100%**	**0%**	**0%**	**0%**	**0%**	**100%**	**0%**		**0%**	**0%**	**100%**	**0%**
Total answers	16	5	4	7	6	3	8	0	0	10	4	16	10	4	10	2
Answers as % of total	**73%**	**31%**	**25%**	**44%**	**38%**	**19%**	**50%**	**0%**	**0%**	**63%**	**25%**	**73%**	**63%**	**25%**	**63%**	**13%**

Update model

Country	OECD in 2002 Ans	OECD in 2002 New observations append	OECD in 2002 Once a year	OECD in 2002 Other periodicity (in month)	HCSO in 2006 Ans	HCSO in 2006 New observations append	HCSO in 2006 Once a year	HCSO in 2006 Other periodicity (in month)	HCSO in 2006 Other Comments
Finland	1		×		3		×	6	×
France	1		×		6		×		
Germany	1	×			2		×		×
Italy	1		×		2		×		
Portugal	1			4	1			60	
Spain	1			4	2		×	60	
Sweden	1		×		1		×		
United Kingdom	1		×		1		×		×
EU-15 Total	8	1	5	2	8	0	7	3	3
%		**13%**	**63%**	**25%**		**0%**	**88%**	**38%**	**38%**
Hungary	2		×		1		×		×
Poland	1			6	1		×		
Slovak Rep.	5	×			9	×	×		
NMS-12 Total	3	1	1	1	3	1	3	0	1
%		**33%**	**33%**	**100%**		**33%**	**100%**	**0%**	**33%**
Norway	1	×			1	×			
Switzerland	1		×		1		×	6	
Non-EU Total	2	1	1	0	2	1	1	1	0
%		**50%**	**50%**	**0%**		**50%**	**100%**	**100%**	**0%**
Total answers	13	3	7	3	13	2	11	4	4
Answers as % of total	**59%**	**23%**	**54%**	**23%**	**41%**	**15%**	**85%**	**31%**	**31%**

Update parameter

Country	OECD in 2002 Ans	OECD in 2002 New observations append	OECD in 2002 Once a year	OECD in 2002 Other periodicity (in month)	HCSO in 2006 Ans	HCSO in 2006 New observations append	HCSO in 2006 Once a year	HCSO in 2006 Other periodicity (in month)	HCSO in 2006 Other Comments
Finland	1		×		3	×			
France	1			4	6		×		
Germany	1	×			2	×	×		
Italy	1	×			2	×			
Netherlands	1		×		1	×	×		
Portugal	1			4	1	×	×		
Spain	1			4	2	×	×		
Sweden	1	×			1	×			
EU-15 Total	8	3	2	3	8	7	5	0	0
%		**38%**	**25%**	**38%**		**88%**	**63%**	**0%**	**0%**
Hungary	2		×		1		×		×
Poland	1			6	1		×		
Slovak Rep.	5	×			9	×	×		
NMS-12 Total	3	1	1	1	3	1	3	0	1
%		**33%**	**33%**	**100%**		**33%**	**100%**	**0%**	**33%**
Norway	1	×			1	×			
Switzerland	1		×		1	×			
Non-EU Total	2	1	1	0	2	2	0	0	0
%		**50%**	**50%**	**0%**		**100%**	**0%**	**0%**	**0%**
Total answers	13	5	4	4	13	10	8	0	1
Answers as % of total	**59%**	**38%**	**31%**	**31%**	**41%**	**77%**	**62%**	**0%**	**8%**

Method(s) used							
	OECD in 2002			HCSO in 2006			
Country	Ans	Internal usage	External usage	Ans	Internal usage	External usage	Eurostat
Denmark	1	×		1	×	×	×
Finland	1	×	×	3	×	×	×
Germany	1	×	×	2	×	×	×
Ireland	1	×	×	1	×	×	
Italy	1	×	×	2	×	×	×
Netherlands	1	×		1	×	×	×
Portugal	1	×		2	×	×	
Spain	1	×		2	×	×	×
United Kingdom	1	×	×	1	×	×	×
EU-15 Total	9	9	5	9	9	9	7
%		**100%**	**56%**		**100%**	**100%**	**78%**
Hungary	2	×		1	×	×	
Poland	1	×		1	×	×	×
Slovak Rep.	5	×	×	9	×	×	×
NMS-12 Total	3	3	1	3	3	3	2
%		100%	33%		100%	100%	67%
Norway	1	×	×	1	×	×	×
Switzerland	1	×		1	×	×	
Non-EU Total	2	2	1	2	2	2	1
%		100%	50%		100%	100%	50%
Total answers	14	14	7	14	14	14	10
Answers as % of total	**64%**	**100%**	**50%**	**64%**	**100%**	**100%**	**71%**

Parameters used in the SA							
	OECD in 2002			HCSO in 2006			
Country	Ans	Internal usage	External usage	Ans	Internal usage	External usage	Eurostat
Finland	1	×		2	×		
Germany	1	×		2	×	×	×
Italy	1	×	×	2	×	×	
Netherlands	1	×		1	×	×	×
United Kingdom	1	×		1	×		
EU-15 Total	5	5	1	5	5	3	2
%		**100%**	**20%**		**100%**	**60%**	**40%**
Hungary	2	×		1	×	×	
Slovak Rep.	5	×		4	×		×
NMS-12 Total	2	2	0	2	2	1	1
%		**100%**	**0%**		**100%**	**50%**	**50%**
Norway	1	×		1	×		
Switzerland	1	×		1	×		
Non-EU Total	2	2	0	2	2	0	0
%		**100%**	**0%**		**100%**	**0%**	**0%**
Total answers	9	9	1	9	9	4	3
Answers as % of total	**41%**	**100%**	**11%**	**41%**	**100%**	**44%**	**33%**

Working/trading day adjustment applied							
	OECD in 2002			HCSO in 2006			
Country	Ans	Internal usage	External usage	Ans	Internal usage	External usage	Eurostat
Denmark	1	×		1	×	×	×
Finland	1	×	×	2	×	×	
Germany	1	×	×	2	×	×	×
Ireland	1	×	×	1	×		×
Italy	1	×	×	2	×	×	×
Netherlands	1	×		1	×	×	×
Spain	1	×		1	×		
United Kingdom	1	×		1	×		
EU-15 Total	8	8	4	8	8	5	5
%		**100%**	**50%**		**100%**	**63%**	**63%**
Slovak Rep.	5	×		1	×		×
NMS-12 Total	1	1	0	1	1	0	1
%		**100%**	**0%**		**100%**	**0%**	**1000%**
Norway	1	×		1	×		
Non-EU Total	1	1	0	1	1	0	0
%		**100%**	**0%**		**100%**	**0%**	**0%**
Total answers	10	10	4	10	10	5	6
Answers as % of total	**45%**	**100%**	**40%**	**45%**	**100%**	**50%**	**60%**

ANNEX III.

NSI's Practices

Central Bureau of Statistics – Republic of Croatia

Introduction

Seasonal adjustment was introduced in the Central Bureau of Statistics (CBS) – Croatia in the year 1996. First department to implement SA in practice was Industrial statistics. Method used was X-11-ARIMA from Canadian Statistics. The treated series from Industry department were NCEA Sections “C”, “D”, “E” and MIGs “AI”, “AE”, “B”, “CD”, “CN”. At the end of year 1999. original X12-ARIMA MS-DOS program from the U.S. Census Bureau was introduced, motivated mainly by the then topical problem of “Y2K”, but also because of new possibilities for seasonal adjustment which offers X12-ARIMA. During the year 2000., series from Construction Department were included. Also, first written methodological manuals for Industry and Construction departments with practical instructions how to use X12-ARIMA program (so-called “Cookbooks”) were published internally.

Change of Software (Interface) of Seasonal Adjustment in CBS

During the year 2001, after some internal courses on seasonal adjustment held in CBS for subject-matter departments by professors from Faculty of Economics - Zagreb with practical examples illustrated by "Demetra", Eurostat's recommended interface for both X12-ARIMA and TRAMO/SEATS programs, it was decided to use "Demetra" as a working software for all series in CBS. Method chosen was X12-ARIMA, which was continuation of the same method from the previous period, although possibility was left opened for some departments to use TRAMO/SEATS, if they estimate it is better suited for their needs.

Respecting requirements from Eurostat in this field, CBS gradually extended seasonal adjustment to series from other departments: distributive trade, tourism, hotels and restaurants, and national accounts, but also began to produce working day adjusted figures.

Recent developments - Croatian-Danish Twinning Project[59]

In the frame of “CARDS Assistance Programme to the Western Balkans” it was the first and only mission to be devoted to “Statistical Analysis of Time Series” within “Component C3” of the project. Mission took place from 9-17th December 2003 in CBS.

Conclusions and recommendations of the Mission were the following:

There is a need for a general policy in CBS on seasonal adjustment. This requires commitment from the top management in order to succeed. The work with seasonal adjustment has to be acknowledged as an integrated part of the normal functions. An idea could be to establish a horizontal working group with both methodologists and subject matter specialists. This working group could consider a number of the following items:

- what software shall be applied in the future: X12-ARIMA or TRAMO/SEATS (besides “Demetra”)? Eurostat recommends “Demetra” and TRAMO/SEATS. The software chosen must be made generally available.
- how shall the division of labour be between the methodology division and the subject matter divisions? If the number of series to be seasonally adjusted is expected to increase, it should be

[59] “Support to the Central Bureau of Statistics of the Republic of Croatia (CBS) in data collection and adoption of the acquis”.

considered to give the subject matter divisions a greater responsibility for running the series and give the methodology division a consulting role.

- which series are to be seasonally adjusted? The minimum solution could be to adjust the series required by EU, but here one could also consider the domestic users. They might not require seasonal adjustment for the moment. However, other Croatian government bodies as the Ministry of Finance and the Croatian National Bank have already introduced seasonal adjustment in their work and it is confusing for users to have ‘competing series’. Another aspect is that many series show strong evidence of seasonal effect, although there are also some with weak seasonal effect or no effect at all. These are easier to interpret if they are seasonal adjusted.
- harmonization of methodological issues, e.g. pre-adjustment and working day corrections.
- harmonization of publication strategy in this field. Today all divisions publish the series recommended by Eurostat – the seasonally adjusted and the trend-cycle. The publication of these series – which are the responsibility of the subject matter divisions – should be done in a uniform way. This applies also to the methodology notes.
-

The Current Seasonal Adjustment Practice in CBS with Some Problems and Open Questions

Currently, according to the Eurostat requirements, seasonal adjustment is carried out in the following departments:

- Industry and energy
- Construction
- Distributive trade
- Tourism
- Hotels and restaurants
- National Accounts

In the Industry and energy department, 23 monthly series are processed, of that 9 for Eurostat (4 for NCEA and 5 for MIGs), method used is TRAMO/SEATS.

In the Construction department, 3 monthly series and 3 quarterly series (with the same variable definition) are processed, method used is X12-ARIMA.

In the Distributive trade department, 2 monthly series are processed, method used is X12-ARIMA.

In the Tourism department, 3 monthly series are processed, method used is X12-ARIMA.

In the Hotels and restaurants department, 1 quarterly series is processed, method used is X12-ARIMA.

In the National accounts department, 9 quarterly series are processed according to NCEA classification, method used is X12-ARIMA.

At present, respecting Eurostat requirements for individual subject-matter departments, trading/working day, national holidays and Easter effect adjustment is performed in Industry and energy and Distributive trade departments using TRAMO/SEATS capabilities in «Demetra».

Industry and energy department is specific because they adjust all their series (SA and WD/TD adjustment) by themselves and use TRAMO/SEATS only. For all the other departments in CBS, person in charge (specialist) is doing the required processing (SA and TD/WD adjustment).

Some open questions and plans for future activities can be summarized as follows:

- is it necessary or recommended to include in adjustment process (SA and/or WD/TD adjustment) more series, also from other departments, although at present there is no such official requirement (obligation) from Eurostat?
- is it necessary to establish a working group for SA at the CBS level (following the recommendations of the aforementioned Danish Mission), whose main purpose would be to harmonise methodological issues between departments, or to leave it partially decentralized (as it is now)?
- is it correct to use different methods (X12-ARIMA or TRAMO/SEATS) in various departments, and even in the same department (e.g. Distributive trade, TD/WD adjustment)? Some departments prefer to cross-check results using different methods on the same series, but they publish results of one – previously agreed - method only.
- which software to use in the future: the newest release of "Demetra" from Eurostat, or announced X13-ARIMA/SEATS from the U.S. Census Bureau, when it becomes available?
- we plan to establish an internal database for ALL time series in CBS, regardless of the fact if they are at present adjusted or not. Such a database should contain short series description (meta-data), original data (figures), SA data and data adjusted for other purposes if required, with defined access rights for employees from particular CBS departments. Technically, it should be located on some server on CBS's LAN, and accessible only internally. Support from our top management is required to accomplish this project.
- concerning quality of seasonal adjustment, we are prepared to adopt quality assurance methods, standards and indicators proposed to Eurostat by those NSI's which are more advanced in this respect than we are.
- may we suggest that after HoSA project is completed, representatives of NSI's who are in charge of seasonal adjustment stay in contact by using existing Eurostat's CIRCA interest group on seasonal adjustment. Maybe some kind of mailing list with combined news and articles from Eurostat, OECD and other European institutions about time series methods and adjustments would be helpful, similar to mailing list from the U.S. Census Bureau?

German Federal Statistical Office (Destatis)

Introduction

Seasonal adjustment was introduced at the German Federal Statistical Office (Destatis) in the year 1971. After an intensive methodological discussion it was decided to use the so-called Berlin Procedure (BV), which is based on a moving (local) regression model approach. To handle the thousands of monthly and quarterly analyses, in 1983 the BV4 version of the procedure was established, which made the running of the procedure nearly completely standardized. In 2004 Destatis introduced the BV4.1 version of the Berlin Procedure, together with a new user-friendly software.

New Policy of Seasonal Adjustment at Destatis since 2000

Since the year 2000 Destatis changed its seasonal adjustment policy fundamental. Due to the fact that the German ministry of economic affairs uses the X12-ARIMA seasonally adjusted data (provided by the German central bank) for two important short term indicators (new orders and production index) in its press releases, the non-professional users became more and more confused about the two different national results of the adjusted data of these two indicators.

In order to avoid this unsatisfying situation Destatis decided to start a co-operation with the central bank for the production of the seasonally adjusted data. The consequence was the introduction of the method X12-ARIMA in Destatis in co-operation with the German central bank for some indicators. Thus X12-ARIMA results are used for the national press releases and the delivery to Eurostat as the national data.

To make the professional users aware of the fact, that seasonal adjustment in general is a complex mathematical estimation procedure and the adjusted data can differ depending on the methods used and the person in charge of the processing of the data, Destatis publishes for all series results from the Berlin Procedure (BV4) as well. With this policy we intend to draw some attention to the fact that especially at the very recent end of the series a “true” seasonally adjusted value does not exist and it might be sensible to draw conclusions on business cycles by considering the results of different seasonal adjustment procedures.

Organisation in Destatis

In general the Subject Matter Departments are responsible for the seasonal adjustment due to their better knowledge of the specifics of the statistics and for reasons of a timely publication of the analyses. Experts from the Mathematical-Statistical Division are responsible for general mathematical and methodological questions concerning seasonal adjustment. They are also responsible for the development of the BV4.1 procedure.

The Re-estimation of the Model and Parameters

Regarding BV4.1 a re-estimation of models is not relevant because of the standardized series-independent approach. Re-estimation of the parameters of the moving regression models is done concurrently. As BV4.1 is based on moving (local) regression models, results concerning past periods (months, quarters) generally are no longer revised if enough additional observations are available.

In general, the ARIMA model, the parameter and the seasonal factors are kept constant for one year by using the X12-ARIMA method. Nevertheless, with every new data value a check of the adequacy of the factors and the model is done at least for the most important series due to quality reasons. Hence projected factors (stored in the database) for the monthly calculation are used, but these factors are compared with the new factors (concurrent estimation of the factors). The decision to re-estimate the factors might be sometimes difficult as it does not exist an objective rule for replacing old factors by updated factors. As a result of this procedure permanent revisions in the main (national) aggregate series cannot be avoided. This might be a main critical point of the X12-ARIMA method in the view of Destatis.

Working Day Effect

Regarding BV4.1 the Subject Matter Departments decide about the trading day model. Generally a model with 8 regressors related to the number of the different weekdays and German public holidays is used. The special effect of Easter is regarded as one of the seasonal influential variables.

For the adjustment with X12-ARIMA the working day effect is estimated by using a RegARIMA model where working days, leap year effects and special national holidays are taken into account. The number of the working days in a five-day week is measured as the deviation from the long-term average of the month in question. Destatis publishes X12-ARIMA working day adjusted series for all main indicators (e.g. production index, new order, turnover, retail trade).

Outliers

Regarding BV4.1, the first step of the procedure is the identification of additive outliers. This is done automatically using a mathematical identification procedure. The experts of the Subject Matter Departments can decide on the probability of the occurrence of additive outliers. Usually the default option is used. Concerning the occurrence of level shifts the experts of the Subject Matter Departments have to provide the BV4.1 procedure with the information. Then the procedure defines the corresponding regression variables and proceeds with the estimation of the regression coefficients.

With X12-ARIMA three types of outliers are considered: additive outliers, level shift and transitory change. In general, the default option in X12-ARIMA is used to identify the outliers. It might be a problem with the default settings at the end of the series and if the indicator is quite volatile. Depending on the volatility of the series the critical value of the outliers is modified by using additional information. For instance expert information is used to deal with the handling of the series which aims to keep the revisions as small as possible.

Aggregation Policy

In principle there is no need for an aggregation policy regarding BV4.1. The procedure is based on fixed linear regression models. Thus there are no differences between the results of the indirect and the direct approach. But in cases where outliers occur or trading day and user-defined regressors are used, the user has to make sure that for all series involved the regressors are identical.

By using X12-ARIMA the direct approach is used for all 4-digit branches and the Main Industrial Groupings (MIGs) for the industrial indicators (e.g. production index, new orders, turnover). For the main aggregates (e.g. total industry) the indirect approach is preferred that puts together the seasonally adjusted MIGs. For quality reasons the indirect aggregates are checked against the direct control series with every new run. However, there is no strict policy for this issue it rather depends on the indicator.

Time Consistency

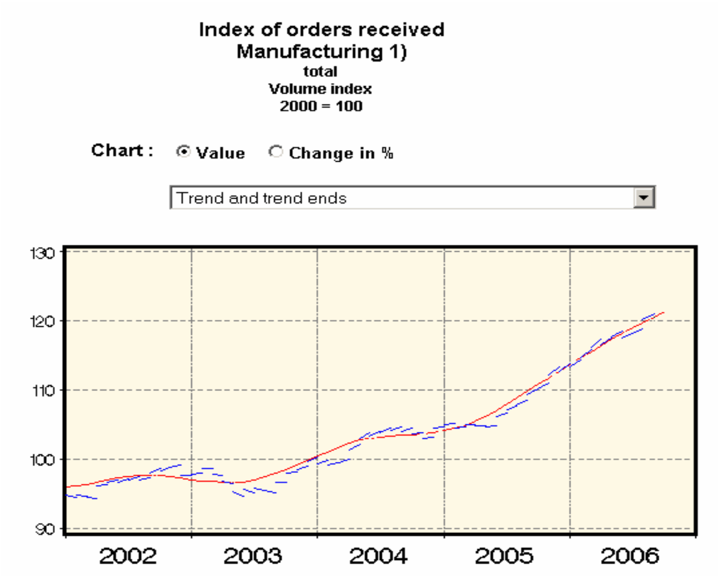
Adaptations of seasonally adjusted series to guarantee time consistency are not carried out on principle because in cases of changing seasonality such adaptations are not justified from a mathematical point of view. The only exception is the realm of national accounts regarding seasonal adjustment with X12-ARIMA.

Dissemination Policy

The primary seasonally and working day adjusted figures, which were presented in the national press release and delivered to Eurostat, are adjusted with X12-ARIMA. As supplementary information Destatis publishes seasonally adjusted data with BV4.1 at its web sites and in GENESIS database. Regarding the results of BV4.1, also trend-cycle and irregular components are published. However, the complexity of the published series can differ depending on the departments.

From the point of view of publication it is a problem that the end of the trend-cycle component is rather uncertain but signals a clear direction. On the Economic Indicator web pages, Destatis illustrates the uncertainty by showing the current trend-cycle component together with the ends of previous trend-cycle components based on shorter series (see the following graph).

Figure 1: The current trend-cycle component and the ends of previous trend-cycle components



Hungarian Central Statistical Office (HCSO)

Introduction

The regulation of unified seasonal adjustment procedure was introduced in the Hungarian Central Statistical Office (HCSO) in April 2004. We developed it in 2001 as a practice recommended for all departments dealing with seasonal adjustment within the HCSO. From the first quarter of 2002 the seasonal adjustment has been going on with the new system.

In 2003 we discussed the experience of the first year both with experts and users. On this basis, in early 2004 the regulation was launched.

In this chapter we write shortly about the reason of standardisation of seasonal adjustment practice, how the system was changed and new practice was introduced.

Change of the Methodology of Seasonal Adjustment in HCSO

In HCSO before 2002 seasonal adjusted data were produced only in a few fields of statistics usually using X11 or X11-ARIMA method.

In 2000-2001 demand increased for publishing more seasonally adjusted data and for using a new method. HCSO felt pressure from two sides: on the one hand domestic users, especially the National Bank of Hungary, on the other hand, the harmonization efforts of Eurostat also gave grounds for the introduction of a new method.

Eurostat required statistical data of the candidate countries not only in the form of gross figures but also working day adjusted figures and seasonally adjusted figures. Eurostat made recommendations about seasonal adjustment in order that the data of different countries should be comparable to each other (Seasonal Adjustment Policy - Some Eurostat Proposals, SAM98 Seminar, Bucharest). Two methods of seasonal adjustment were recommended: X12-ARIMA and TRAMO/SEATS. Eurostat has developed a free user-friendly interface (Demetra), which includes both methods.

The Current Seasonal Adjustment Practice of HCSO

After experimental calculations, HCSO favoured the TRAMO/SEATS method against X12-ARIMA. We use the TRAMO/SEATS method for seasonal adjustment with Demetra.

In the HCSO currently we seasonally adjust only monthly and quarterly series.

We usually adjust indices compared to a base year, but the adjustment of absolute figures and indices compared to a given month of a given year also occurs.

We do not adjust same period of previous year = 100% type indices or same period of base year = 100% type indices, because we would lose information and the dynamics of the series would change, too.

The Revision of the Model and Parameters

Statistical Offices including HCSO most often publish seasonally adjusted data and trend regularly of the same time series as the series are supplemented with observations of recent periods. It is obvious that the series include more observations, hold more information for the decomposition, and for this reason the seasonally adjusted data and trend retrospectively change compared to former results: revision occurs.

For HCSO the quality of the results is important but it is also important that revisions should be as small as possible, so we chose the revision of the model and the parameters once a year. This fixation of the model and the parameters usually takes place at the receipt of the last observation of the year, and the results using the new model are published with the first data of the next year. Revision of the model and the parameters can happen irregularly during the year if revision concerning unadjusted gross data occurs for observations that the preceding revision was based on. Revision can also occur when the diagnostics of the seasonal adjustment software indicate a significant deviation from the fixed model and parameters.

Division of Labour

In HCSO we organized a division of labour for the seasonal adjustment. The Subject Matter Departments do the adjustment of their series during the year, they have the necessary expert information, and they are responsible for the publication of the results. At the Statistical Research and Methodology Departments, we do the yearly model- and parameter-revision, the mathematical statistical control of the results during the year, the methodological coordination of seasonal adjustment, and follow the new scientific results in the field of seasonal adjustment.

Working Day Effect

TRAMO can automatically test the significance of working day and Easter effect for a given time series, but it is practical to use the available expert (auxiliary) information about the occurrence of these effects. Expert information is especially valuable in the case of short time series (which is a frequent case in HCSO) when statistical tests are not reliable enough. It is worth paying attention for the sign of regression coefficients which should be explainable.

Hungarian holidays are taken into consideration for handling working day effect.

On the basis of a Eurostat recommendation about the working day adjustment of short-term statistics (STS), we assure that the average of the working day adjusted data in the base-year is 100%, the same as for the unadjusted data. This is done by rescaling the working day adjusted series. It means that we divide each value of the adjusted series by the average of the adjusted base-year data. The rescaling does not change the dynamics of the time series, which means that the proportion of values of different periods are the same, only the indices compared to the base-year change actually. The recommendation does not concern the seasonally adjusted data, so we do not rescale them.

Outliers

We consider three types of outliers: additive outlier, transitory change and level shift. Outliers can also be handled automatically by TRAMO: it detects automatically the date and type of the outliers then it makes regression variables to correspond to each outlier found and estimates the regression coefficients. We consider expert information about outliers: whether there can be an outlier in a given period and if TRAMO finds automatically an outlier then what can be the economical, social, weather or other external factor that explains it. Expert information is especially important about outliers at the end of the series because the types of these outliers are uncertain from a mathematical point of view, and change of type later leads to large revisions. The number of outliers in a time series is limited to 5% proportional to the number of all observations of the series. If there is need to use more outliers – it is often the case for short quarterly series – this 5% default value can be adjusted.

Aggregation Policy

In HCSO we often have to seasonally adjust aggregated time series and its subseries (components) too. We usually choose direct adjustment.

The problem occurs for aggregation by time: yearly aggregate of seasonal data does not necessarily equal the yearly aggregate of the unadjusted data. If it is a requirement that these two aggregates should be the same, then the difference can be distributed along the seasonal adjusted data of the year. We do not use this solution as far as possible because it reduces the quality of seasonal adjustment.

There are aggregation problems about working day adjusted series too, solutions are the same as for seasonally adjusted series.

Dissemination Policy

HCSO often publishes working day adjusted data in addition to or instead of seasonally adjusted data. Working day adjusted series are produced from raw series by filtering out not the seasonal effect but only the working day and Easter effect. There is a methodological harmony between working day adjustment and seasonal adjustment because we use for working day adjustment the same working day and Easter effect which were estimated during the seasonal adjustment process.

From the point of view of publication it is a problem that the end of the trend is rather uncertain therefore it can change significantly if we seasonally adjust the series supplemented by additional observations. Views are different in this question: there are some who think this uncertainty should be indicated on the graph of trend, others have the opinion that the end of trend is uncertain in any case independently of seasonal adjustment method, so it is unnecessary to indicate

In HCSO there is no unified policy concerning the publication of trend therefore the Departments decide about it on their own authority. Currently Departments of HCSO use three options: publish trend in full length, publish trend without its end, or do not publish trend.

Problems

In HCSO currently the biggest problem of seasonal adjustment is that the available homogeneous time series are often short. This factor reduces the quality of seasonal adjustment considerably. There are some exceptions, but most of the series start from 1998. Its reason is that during the rebasement of the series to 2000 the backward calculation of the series for periods before 1998 did not usually take place because of methodological problems. The shortness of the series is the main reason behind the phenomenon that the yearly model and parameter revision cause a large revision of seasonally adjusted data. The date and type of outliers often change, the statistical test concerning working day effect is not reliable enough and this is the reason that working day effect is significant for a series in one year then it is not at the next model revision, or vice versa.

Central Statistical Office of Poland (CSO)

Introduction

In 2002 the President of the Central Statistical Office of Poland took a decision to set up a Task Force on Seasonal Adjustment which consisted of experts involved in seasonal adjustment issues in subject matter departments and experts in methodology of seasonal adjustment. Their task was to propose methodological and organisational solutions concerning implementation of seasonal adjustment at the CSO taking into account the recommendations of Eurostat in this area. At the beginning of the activities of the group the assessment of what has been already done in this field at the CSO was prepared. The experts involved in the activities of the group analysed two methods recommended by Eurostat (TRAMO/SEATS, X12-ARIMA) with the use of the CSO data (National Accounts, STS, BTS). The results were presented to the Scientific Statistical Council of the CSO. On the basis of that analysis the TRAMO/SEATS method was chosen. The experts of the Task Force prepared also three papers on the methodology of seasonal adjustment for the internal use ("Time series and its components", "Methods of seasonal adjustment", "Models of seasonal adjustment").

In February 2005 the group finalised its activities and the co-ordinator of the seasonal adjustment at the CSO was appointed. In April 2005 a course on seasonal adjustment conducted by foreign experts was organised. A short note on seasonal adjustment published on the CSO website was prepared including information on the method used at the CSO and the names of contact persons ("Seasonal adjustment of time series").

Change of the Methodology of Seasonal Adjustment at the CSO

Before 2005 at the CSO data were seasonally adjusted with the use of different methods chosen by the experts responsible for certain type of data. In case of STS for manufacturing industry and construction till 2002 it was the X11-ARIMA method and since 2002 – the TRAMO/SEATS method included in Demetra. Selected indices from BTS were seasonally adjusted since 1997 with the X11-ARIMA method implemented in SAS. For National Accounts and retail trade (STS) the TRAMO/SEATS method included in Demetra was used from the beginning.

The Current Seasonal Adjustment Practice of CSO

In May 2005 it was decided to use at the CSO the unified seasonal adjustment procedure for all kinds of data. The adopted method is TRAMO/SEATS.

The Refreshment of the Model and Parameters

The model is created once a year while parameters are re-estimated after the addition of every new observation. For retail trade (STS) parameters are re-estimated with the model. In case of the yearly change of the model all historical data are corrected, in case of the monthly re-estimation for STS last month is changed.

Division of Labour

Seasonal adjustment is done by experts responsible for specific domains of statistics (e.g. National Accounts, STS, LCI, Worked – Hours, BTS) in subject matter departments. In case of problems they could consult one of the experts in methodology from the Task Force. Problems connected with seasonal adjustment are also discussed at the meetings organised by the co-ordinator of seasonal adjustment. Those meetings provide also an opportunity for the exchange of experience and information among the concerned experts.

Working Day Effect

The working day effect is removed in compliance with the recommendations of Eurostat. The Polish national holidays are taken into account.

Outliers

In case of Polish data there three kinds of outliers are taken into account: additive outliers, level shift and temporary change. In most cases they are detected by test.

Aggregation Policy

Direct adjustment is applied for all series seasonally adjusted at the CSO of Poland.

Dissemination Policy

Data seasonally adjusted are send to the Eurostat and published in the CSO publications, mainly in the monthly Statistical Bulletin, also in some specialist publications. At present raw and seasonally adjusted data are published together: indices of sold production of industry and construction and assembly production, deflated turnover in retail trade, indices of gross domestic product and selected BTS indices.

Problems

In case of some time series the main problem is their length – an addition of new data results in a significant revision of historical data. Another problem encountered is the fact that the detection of working days effect procedure does not always provide reliable results.

ANNEX IV.

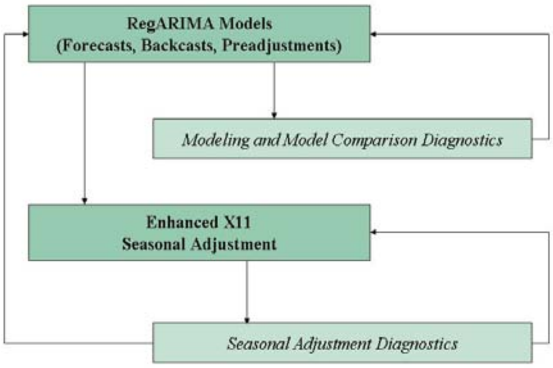
Methods and Software

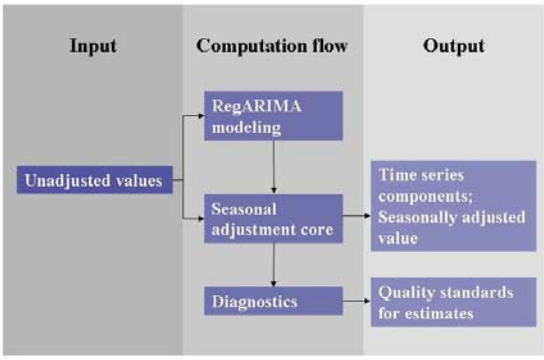
X12-ARIMA

X12-ARIMA was developed by US Census Bureau as an extended and improved version of the Statistics Canada X11-ARIMA method (Dagum (1980)). The program runs through the following steps. First the series is modified by any user-defined prior adjustments. Then the program fits a regARIMA model to the series in order to detect and adjust for outliers and other distorting effects to improve forecasts and seasonal adjustment. The program then uses a series of moving averages to decompose a time series into three components. In the last step a wider range of diagnostic statistics are produced, describing the final seasonal adjustment, and giving pointers to possible improvements which could be made.

The X12-ARIMA method is best described by the following flowchart, as presented by David Findley and by Deutsche Bundesbank.

Figure 4-3: Flowcharts of the X12-ARIMA method





RegARIMA Models

RegARIMA models are able to detect and adjust for outliers and other distorting effects to improve the forecasts and seasonal adjustment. They also consent to detect and estimate additional components (e.g. calendar effects) and extrapolate the time series forward (forecast) and backward (backcast). RegARIMA is the name of the statistical modeling facility in X12-ARIMA. It enables two types of models to be fitted to a time series. First, it introduces an ARIMA model in order to take account of trend and seasonality in data. In X12-ARIMA, the program can be allowed either to choose the most appropriate form of ARIMA model for an individual series (using the model fitting criteria built into the program), or to apply the user specified ARIMA model.

The 'reg' part of RegARIMA refers to the options which enable the basic ARIMA model to be enhanced with additional regression variables. These might take the form of dummy variables set up to model the effect of, for example an additive outlier, or might be a direct explanatory variable. The standard seasonal ARIMA model is therefore generalised to a model including regression parameters and an error term following an ARIMA process:

$$Y_t = X_t \beta + Z_t ,$$

where Y_t is the series to model, X_t a matrix of fixed regressors (trading day, holiday or calendar effects, outliers effects, user defined and other effects), β the parameters vector and Z_t an ARIMA process.

The predefined regression variables in X12-ARIMA are:

- *Outliers*: additive outlier, level shift, temporary ramp
- *Calendar effects*: trading day (for flows and stock), length of month, leap year, Easter holiday, Labor day, Thanksgiving
- *Constant trend*
- *Fixed seasonal effect*

With regard to the choice of model specification, a large set of test statistics are computed (AIC, AICC, Hannan-Quinn criterion, BIC, Chi-squared tests, t-statistics). More generally, all the statistical inference about the model has been enhanced, introducing tests to evaluate the transformation (additive or multiplicative) to be applied to the series, the inclusion of trading day effects, the length of the Easter effect.

Enhanced X-11 Seasonal Adjustment[20]

The X12-ARIMA program uses moving averages throughout its iterations in order to decompose the original time series into trend-cycle, seasonal and irregular components. The program uses moving averages for two different purposes: to estimate the trend component and to estimate the seasonal component. It uses two different types of moving averages to estimate the trend component – one before the seasonal component has been removed and one after.

Let Y_t a monthly series without extreme values, trading-day effects, etc. (or series that has been preadjusted for such effects) and extended by forecasts and backcasts. For the following algorithm multiplicative decomposition is used.

Stage 1. Initial Estimates

Step 1.1: *Initial Trend Estimate*

Compute a centered 12-term (13-term) moving average as a first estimate of the trend:

$$T_t^{(1)} = \frac{1}{24}Y_{t-6} + \frac{1}{12}Y_{t-5} + \cdots + \frac{1}{12}Y_t + \cdots + \frac{1}{12}Y_{t+5} + \frac{1}{24}Y_{t+6}$$

Step 1.2: *Initial Seasonal-Irregular component or "SI Ratio"*

The ratio of the original series to the estimated trend is the first estimate of the detrended series:

$$SI_t^{(1)} = \frac{Y_t}{T_t^{(1)}}$$

$$SI_t^{(1)} = Y_t - T_t^{(1)}$$

Step 1.3: *Initial Preliminary Seasonal Factor*

5-term weighted moving average (3x3) is calculated for each month of the seasonal-irregular ratios (SI) to obtain preliminary estimates of the seasonal factors:

$$\hat{S}_t^{(1)} = \frac{1}{9}SI_{t-24}^{(1)} + \frac{2}{9}SI_{t-12}^{(1)} + \frac{3}{9}SI_t^{(1)} + \frac{2}{9}SI_{t+12}^{(1)} + \frac{1}{9}SI_{t+24}^{(1)}$$

[20] Findley, Monsell, Bell, Otto, Chen (1998)

Step 1.4: *Initial Seasonal Factor*

Crude "unbiased" seasonal from step 1.3 via centering:

$$S_t^{(1)} = \frac{\hat{S}_t^{(1)}}{\frac{1}{24}\hat{S}_{t-6}^{(1)} + \frac{1}{12}\hat{S}_{t-5}^{(1)} + \cdots + \frac{1}{12}\hat{S}_{t+5}^{(1)} + \frac{1}{24}\hat{S}_{t+6}^{(1)}}$$

$$S_t^1 = \hat{S}_t^{(1)} - \left(\frac{\hat{S}_{t-6}^{(1)}}{24} + \frac{\hat{S}_{t-5}^{(1)}}{12} + \cdots + \frac{\hat{S}_{t+5}^{(1)}}{12} + \frac{\hat{S}_{t+6}^{(1)}}{24} \right)$$

Step 1.5: *Initial Seasonal Adjustment*

$$A_t^{(1)} = \frac{Y_t}{S_t^{(1)}}$$

$$A_t^{(1)} = Y_t - S_t^{(1)}$$

Stage 2. *Seasonal Factors and Seasonal Adjustment*

Step 2.1: *Intermediate Trend*

Calculate an intermediate trend (Henderson trend, see Findley at al. (1998)) of length $(2H+1)$ for data-determined *H*.

$$T_t^{(2)} = \sum_{j=-H}^{H} h_j^{(2H+1)} A_{t+j}^{(1)} \, ,$$

where $h_j^{(2H+1)}$ $\left(-H \le j \le H, h_j = h_{-j}\right)$ are the $(2H+1)$-term Henderson weights.

Step 2.2: *Final SI Ratios*

Calculate the detrended series from Henderson trend:

$$SI_t^{(2)} = \frac{Y_t}{T_t^{(2)}}$$

$$SI_t^{(2)} = Y_t - T_t^{(2)}$$

Step 2.3: *Preliminary Seasonal Factor*

Calculate final "biased" seasonal factors via a "3x5" seasonal moving average:

$$\hat{S}_t^{(2)} = \frac{1}{15} SI_{t-36}^{(2)} + \frac{2}{15} SI_{t-24}^{(2)} + \frac{3}{15} SI_{t-12}^{(2)} + \frac{3}{15} SI_t^{(2)} + \frac{3}{15} SI_{t+12}^{(2)} + \frac{2}{15} SI_{t+24}^{(2)} + \frac{1}{15} SI_{t+36}^{(2)}$$

Step 2.4: *Seasonal Factor*

Calculate final "unbiased" seasonal factors via centering:

$$S_t^{(2)} = \frac{\hat{S}_t^{(2)}}{\frac{1}{24}\hat{S}_{t-6}^{(2)} + \frac{1}{12}\hat{S}_{t-5}^{(2)} + \cdots + \frac{1}{12}\hat{S}_{t+5}^{(2)} + \frac{1}{24}\hat{S}_{t+6}^{(2)}}$$

$$S_t^{(2)} = \hat{S}_t^{(2)} - \left(\frac{\hat{S}_{t-6}^{(2)}}{24} + \frac{\hat{S}_{t-5}^{(2)}}{12} + \cdots + \frac{\hat{S}_{t+5}^{(2)}}{12} + \frac{\hat{S}_{t+6}^{(2)}}{24}\right)$$

Step 2.5: *Seasonal Adjustment*

$$A_t^{(2)} = \frac{Y_t}{S_t^{(2)}}$$

$$A_t^{(2)} = Y_t - S_t^{(2)}$$

Stage 3. *Final Henderson Trend and Final Irregular*

Step 3.1: *Final Trend*

Final trend from a Henderson trend filter determined from data:

$$T_t^{(3)} = \sum_{j=-H}^{H} h_j^{(2H+1)} A_{t+j}^{(2)}$$

Step 3.2: *Final Irregular*

Final irregular factors as ratios between the seasonally adjusted series from Stage 2 and the final trend from Step 3.1:

$$I_t^{(3)} = \frac{A_t^{(2)}}{T_t^{(3)}}$$

$$I_t^{(3)} = A_t^{(2)} - T_t^{(3)}$$

Estimated Decomposition:

$$Y_t = T_t^{(3)} S_t^{(2)} I_t^{(3)}$$

$$Y_t = T_t^{(3)} + S_t^{(2)} + I_t^{(3)}$$

Trend Filter Choices

The first trend estimation (in Stage 1) is always 2x12 or 2x4. The Henderson trend filter choices (Step 2.1, 3.1) are based on noise-to-signal ratios, the size of the irregular variations relative to those of the trend and labelled I/C in the X12 output. If $I/C < 1$, the 9-term Henderson filter $(H = 4)$ is used. Otherwise, in Stage 2, the 13-term filter $(H = 6)$ is used. In Stage 3, the 13-term filter is used when $1 < I/C < 3.5$, but the 23-term Henderson filter $(H = 11)$ is used when $I/C \geq 3.5$.

Seasonal Filter Choices

The criterion for selection of the seasonal moving average is based on the global I/S, which measures the relative size of irregular movements and seasonal movements averaged over all months or quarters. It is used to determine what seasonal moving average is applied using the following criteria:

I/S	Seasonal Moving Average
$0 < I/S < 2.5$	3x3
$3.5 \leq I/S < 5.5$	3x5
$6.5 \leq I/S$	3x9

The global I/S ratio is calculated using data that ends in the last full calendar year available. If $2.5 \le I/S < 3.5$ or $5.5 \le I/S < 6.5$ then the I/S ratio will be calculated using one year less of data to see if the I/S ratio than falls into one of the ranges given above. The year removing is repeated either until the I/S ratio falls into one of the ranges or after five years a 3x5 moving average will be used.

Diagnostics

X12-ARIMA provides the diagnostic tables of X11 and X11-ARIMA, as well as the M1-M11 quality control statistics of X11-ARIMA (Lothian and Morry (1978)). It also has important additional diagnostics, including spectrum estimates for the presence of seasonal and trading day effects, the sliding spans and revision history diagnostics of the stability of seasonal adjustment. See Findley, Monsell, Bell, Otto and Chen (1998) for more details. The sliding spans and revisions histories are directly interpretable, whereas M1-M11 are indirect measures.

Versions of the X12-ARIMA Programs

PC and Unix versions of the software are available on the U.S. Census Bureau website (http://www.census.gov/srd/www/x12a/).

In addition a SAS/Graph program (X12-Graph) is available that allows users to generate useful diagnostics from X12-ARIMA output.

Other software or interfaces, where you can find X12-ARIMA:

- Demetra
- SAS
- EVIEWS
- GAUSS
- OxMetrics (GiveWin)
- GRETL
- R, …

TRAMO and SEATS

TRAMO (**T**ime Series **R**egression with **A**RIMA Noise, **M**issing Observations and **O**utliers) and SEATS (**S**ignal **E**xtraction in **A**RIMA **T**ime **S**eries) are linked programs originally developed by Victor Gomez and Agustin Maravall at Bank of Spain.

The two programs are structured so as to be used together, both for in-depth analysis of few series or for routine applications to a large number of them, and can be run in an entirely automatic manner. When used for seasonal adjustment, TRAMO preadjust the series to be adjusted by SEATS. The two programs are intensively used at present data-producing and economic agencies, including Eurostat and the European Central Bank.

Programs TRAMO and SEATS provide a fully model-based method for forecasting and signal extraction in univariate time series. Due to the model-based features, it becomes a powerful tool for detailed analysis of series.

Program TRAMO

TRAMO is a program for estimation, forecasting and interpolation of regression models with missing observations and ARIMA errors, in the presence of possibly several types of outliers.

The program is aimed at monthly or lower frequency data, the maximum number of observations is 600 and the minimum depends on the periodicity of the data (in particular 16 for quarterly and 36 for monthly data).

The basic methodology is described in Gómez and Maravall (1992, 1994, 1996, and 2001a) and Gómez, Maravall and Peña (1999).

Given the vector of observations:

$$Y_t = (y_{t_1}, \ldots, y_{t_n})', \qquad \textbf{(5)}$$

where $0 < t_1 < \ldots < t_n$.

The program fits the regression model

$$Y_t = X_t'\beta + Z_t, \qquad \textbf{(6)}$$

where $\beta = (\beta_1, \ldots, \beta_m)$ is the vector of regression coefficients, $X_t' = (X_{1t}, \ldots, X_{mt})$ denotes the m regression variables and Z_t follows a general ARIMA (Seasonal ARIMA) process

$$\phi_p(B)\Phi_P(B^s)\nabla^d\nabla_s^D Z_t = \theta_q(B)\Theta_Q(B^s)\varepsilon_t\text{[21]}. \qquad \textbf{(7)}$$

The model may contain a constant term (μ), equal to the mean of the differenced series $\nabla^d\nabla_s^D = (1-B)^d(1-B^s)^D$. In practice, this parameter is estimated as one of the regression parameters in equation (2).

Initial estimates of the parameters can be input by the user, set to the default values, or computed by the program.

The regression variables can be input by the user (such as economic variables thought to be related with Y_t), or generated by the program. The variables that can be generated are trading day, Easter effect and intervention variables of the type:

[21] See Basic Definitions

- Dummy variables (like additive outliers);
- Any possible sequence of ones and zeros;
- $1/(1-\delta B)$ of any sequence of ones and zeros, where $0 < \delta \leq 1$;
- $1/(1-\delta_S B^S)$ of any sequence of ones and zeros, where $0 < \delta_S \leq 1$;
- $1/(1-B)(1-B^S)$ of any sequence of ones and zeros.

The program:

- estimates by exact maximum likelihood (or unconditional/conditional least squares) the parameters in (2) and (3);
- detects and corrects for several types of outliers;
- computes optimal forecasts for the series, together with their MSE;
- yields optimal interpolators of the missing observations and their associated MSE;
- contains option for automatic model identification and automatic outlier treatment.

1. Estimation of the regression parameters (including intervention parameters and outliers, and the missing observations among the initial values of the series) and the ARIMA model parameters can be made by exact maximum likelihood or by joint estimation. By default, the exact likelihood method is employed and the unconditional and conditional least squares methods are available as options.

Estimation of regression parameters is made by using first the Cholesky decomposition of the inverse error covariance matrix to transform the regression equation. Then, the resulting least squares problem is solved by applying the QR algorithm, where the Householder orthogonal transformation is used. This procedure yields an efficient and numerically stable method to compute general least square estimators of the regression parameters, which avoids matrix inversion.

2. The program has a facility for detecting outliers and for removing their effect; the outliers can be entered by the user or they can be automatically detected by the program, using an original approach based on Tsay (1986) and Chen and Liu (1993). The outliers are detected one by one, and multiple regressions are used to detect spurious outliers. The procedure used to incorporate or reject outliers is similar to the stepwise regression procedure for selecting the "best" regression equation. Regression parameters are initialized by OLS and the ARMA model parameters are first estimated with two regressions, as in Hannan and Rissanen (1982). Next, the Kalman filter and the QR algorithm provide new regression parameter estimates and regression residuals. For each observation, *t*-tests are computed for four types of outliers. If there are outliers whose absolute *t*-values are greater than a pre-selected critical level *C*, the one with the greatest absolute *t*-value is selected. Otherwise, the series is free from outliers and the algorithm stops. If some outlier has been detected, the series is corrected by its effect and the ARMA model parameters are first re-estimated. Then, a multiple regression is performed using the Kalman filter and the QR algorithm. If there are some outliers whose absolute *t*-values are below the critical level *C*, the one with the lowest absolute *t*-value is removed from the regression and the multiple regression is re-estimated. In the next step, using the regression residuals provided by the last multiple regression, *t*-tests are computed for the four types of outliers and for each observation. If there are outliers whose absolute *t*-values are greater than the critical level *C*, the one with the greatest absolute *t*-value is selected and the algorithm goes on to the estimation of the ARMA model parameters to iterate. Otherwise the algorithm stops.

The four types of outliers considered are additive outlier, innovational outlier, level shift and transitory change.

3. For forecasting, the ordinary Kalman filter or the square root filter options are available. These algorithms are applied to the original series. For more detailed discussion see Gómez and Maravall (1993).

4. Missing observations can be handled in two equivalent ways. In the first case interpolation of missing values is made and is described in Gómez and Maravall (1994). The second one consists of assigning a tentative value and specifying an additive outlier to each missing observation. See Gómez, Maravall and Peña (1999) for more details.

5. The program also contains a facility to pre-test for the log-level specification and if appropriate for the possible presence of trading day and Easter effects; it further performs an automatic model identification of the ARIMA model.

Finally the program combines the facilities for automatic detection and correction of outliers and automatic ARIMA model identification just described in an efficient way, so that has an option for automatic model identification of a nonstationary series in the presence of outliers.

The default model in TRAMO is the so-called Airline model, popularized by Box and Jenkins (1970). The model is given by the equation

$$\nabla\nabla_S Z_t = (1+\theta B)(1+\Theta B^S)\varepsilon_t, \qquad \textbf{(8)}$$

with $-1 \le (\theta, \Theta) \le 1$. It is often found an appropriate for many series (see the large-scale study in Fischer and Planas (2000)) and displays many convenient features; in particular it encompasses many other models, including models with close to deterministic trend or seasonality, or models without seasonality. For every short series, for which the automatic model identification is unreliable, TRAMO relies heavily on the Airline model specification.

Although TRAMO can obviously be used by itself, for example, as a forecasting program, it can also be seen as a program that polishes a contaminated ARIMA series. That is, for a given time series, it interpolates the missing observations, identifies outliers and removes their effect, estimates trading day and Easter effect, etc., and eventually produces a linear purely stochastic process (i.e. the ARIMA model). Thus, TRAMO, can be used as a pre-adjustment process to SEATS (see below), which decomposes then the “linearized series” and its forecasts into its stochastic components.

Program SEATS

SEATS (Signal Extraction in ARIMA Time Series) is a program for decomposing a time series into its unobserved components (i.e. for extracting from a time series its different signals), following an ARIMA-model-based method. The method was developed from the work of Cleveland and Tiao (1976); Box, Hillmer and Tiao (1978), Burman (1980), Hillmer and Tiao (1982), Bell and Hillmer (1984); Maravall and Pierce (1987) and Maravall (1988) in the context of seasonal adjustment of economic time series. In fact, the starting point of SEATS was a preliminary program built by Burman for seasonal adjustment at the Bank of England (1982 version).

The program decomposes a series that follows model, for the differenced series of z_t in (3), into several components. The decomposition can be multiplicative or additive. Since the becomes the second by taking logs, we shall use in the discussion an additive model, such as

$$x_t = \sum_i x_{it},$$

where x_{it} represents a component, The components that SEATS considers are:

x_{pt} = the **trend-cycle** component;

x_{st} = the **seasonal** component;

x_{ct} = the **transitory** component;

x_{ut} = the **irregular** component.

Broadly, the trend-cycle component captures the low frequency variation of the series and displays a spectral peak at frequency 0. The seasonal component, in turn, captures the spectral peaks at seasonal frequencies; and the irregular component captures erratic, white noise behaviour and hence has a flat (constant) spectrum. The transitory component is a zero-mean stationary component that picks up transitory fluctuations that should not contaminate the trend-cycle or seasonal component and are not white noise. The components are determined and fully derived from the structure of the (aggregate) ARIMA model for the observed series, which can be directly identified from the data.

Like TRAMO, SEATS is aimed at monthly or lower frequency data and has the same restrictions on the maximum and minimum number of observations.

The decomposition assumes orthogonal components and each one will have in turn an ARIMA expression. In order to identify the components, we will require that (except for the irregular one) they be clean of noise. This is called the “canonical” property, and implies that no additive white noise can be extracted from a component that is not the irregular one. The variance of the latter is, in this way, maximized and on the contrary the trend-cycle and seasonal component are as stable as possible. Although an arbitrary assumption, since any other admissible component can be expressed as the canonical one plus independent white-noise, lacking a priori information on the noise variance, the assumption seems rather sensible.

The model that SEATS assumes is that of a linear time series with Gaussian innovations. In general, SEATS is designed to be used with the companion program TRAMO, which removes from the series special effects. TRAMO passes to SEATS the linearized and the ARIMA model for this series. When no outliers or deterministic effects have to be removed and there are no missing values, SEATS can be used by itself because it also contains an ARIMA estimation routine. This routine is also used when TRAMO model should be modified in order to decompose the series (such is the case, for example, when TRAMO model does not accept an admissible decomposition). In either case, SEATS performs a control on the AR and MA roots of the model.

SEATS computes new residuals for the series in the following way. SEATS uses the ARIMA model to filter the linearized series and estimates by maximum likelihood the residuals that correspond to the observations lost by differencing. In this way, SEATS assigns a residual for each period spanned by the original series. The SEATS residuals are called “extended residuals”; for the overlapping periods, they are very close to the TRAMO ones. The program proceeds then to decompose the ARIMA model. This is done in the frequency domain. The spectrum (or pseudospectrum) is partitioned into additive spectra, associated with the different components. (These are determined, mostly, from the AR roots of the model.) The canonical condition identifies a unique decomposition, from which the ARIMA models for the components are obtained (including the component innovation variances).

Further details can be found in Maravall (1988, 1993, 1995), Gomez and Maravall (1992, 2001b) and Maravall and Planas (1999). For a basic introduction to the time series analysis concepts and tools in connection with TRAMO/SEATS, see Kaiser and Maravall (2000).

As in TRAMO, the default model in SEATS is the Airline model, given by (4), which provides very well behaved estimation filters for the components.

As a general rule, additive outliers and transitory changes are added to the irregular component, and level shifts to the trend. Trading day and Easter effects are added to seasonal component, as well as holiday effect; their sum is called calendar effect. Regression variables can be added to any of the components, or (by default) form a separate component.

Program TERROR

TERROR ("TRAMO for Errors") is an application to quality control of data – in particular, to the detection of errors in reported (time series) data – which is already being used by several agencies. Program TERROR is designed to handle large sets of time series with a monthly or lower frequency of observation, and specifies a particular configuration of TRAMO, that will applied to each to each time series, based on the automatic model identification and outlier correction procedure.

For each series, the program automatically identifies an ARIMA model and detects and corrects for several types of outliers. (It also interpolates missing observations if there are any.) Next, the one-period-ahead forecast of the series is computed and compared with the new observation (this new observation is not used for estimation). In brief, when the forecast error is, in absolute value, larger than some a priori specified limit, the new observation is identified as a possible error. More details are provided in Caporello and Maravall (2003), and Luna and Maravall (1999).

Versions of the TRAMO and SEATS Programs

Several versions of the programs are made available at the Bank of Spain (www.bde.es).

The *DOS versions* are widely used and are particularly helpful when many series are jointly treated.

Program *TSW* a Windows version is the most widely used at present. Notably, the capacity to treat many series at once (metafiles) has bean considerably expanded and provides a much richer output.

FAMEST is an interface of TRAMO/SEATS with FAME under Windows.

TSMATLAB is an interface that permits to run TRAMO and SEATS as a MATLAB is provided.

LINUXST is a Linux version of TRAMO/SEATS.

Other software or interfaces, where you can find TRAMO/SEATS:

- Demetra
- SAS
- EVIEWS
- Modeleasy+
- GRETL
- Confort
- Mathematica
- R, …

The BV4.1 Procedure

Introduction

In Germany, the decomposition and the seasonal adjustment of economic time series with the so-called Berlin Procedure (BV) have a long tradition. The mathematical core – a moving (local) regression model approach – was developed in the late sixties at the Berlin Technical University and the German Institute for Economic Research (DIW) (Nullau, Heiler et al. (1969)). Shortly after (1972), the Federal Statistical Office (Destatis) established a first practicable version of the procedure to provide the general public with information on trends and seasonally adjusted data of major business-cycle indicators. From 1983 the BV4 version of the procedure was used, a version aimed at a largely standardization of the procedure (Nourney, M. (1983), (1984)). The standardization was done by fixing the linear regression models of the approach. The choice of the models was based on frequency domain characteristics (gain function, phase delay function) of the connected linear filters to estimate the (unobservable) trend-cycle component and to seasonally adjust the series.

In the course of 2004, BV4 was replaced by the new version BV4.1 (Speth, H.-Th. (2004)) with methodological improvements concerning the estimation of outliers and calendar effects. In addition, the user can now specify explanatory variables, which are to be considered with the analysis. Detailed information on BV4.1 can be found on http://www.destatis.de/mv/e/methueb.htm .

Codes

O = original series,

T = trend-cycle component (without level shift component),

S = seasonal component,

CA = calendar component,

U^+ = user-defined component (including level shifts),

EX = component of additive outliers,

R = residual component,

ε = error term,

$T_i = i^{th}$ trend-cycle regressor,

$S_i = i^{th}$ seasonal regressor,

$CA_i = i^{th}$ calendar regressor,

$U_i^+ = i^{th}$ series specific user-defined regressor,

$EX_i = i^{th}$ series specific outlier dummy regressor,

N = length of the time series.

Brief outline of the mathematical strategies of the BV4.1 procedure

With BV4.1, it is possible to analyse monthly and quarterly time series.

The first part of the BV4.1 procedure is the identification of (potential) additive outliers. It is based initially on the assumption that within sufficiently short moving time intervals with fixed length - the so-called basic spans - the time series is the realisation of a Normal stationary process. That way the (conditional) expected values for the time series values directly left and/or right from outside of the particular basic spans (backward and forward identification of outliers) are determined. If the difference between an observation and the thus determined (conditional) expected value is more than a fixed multiple (sigma limit) of its standard deviation, then the observation is regarded as an outlier.

In the second part of the procedure the integrated estimation of outliers, calendar effects and of the effects of series specific user-defined variables is accomplished. Based on the general additive model for time series decomposition

$$O = T + S + CA + U^{+} + EX + R,$$

this is done taking as starting point the following linear regression model

$$O = \sum_{i=1}^{h} \mu_i T_i + \sum_{i=1}^{k} \nu_i S_i + \sum_{i=1}^{l} \alpha_i CA_i + \sum_{i=1}^{m} \beta_i U_i^{+} + \sum_{i=1}^{n} \gamma_i EX_i + \varepsilon$$

($EX_i =$ series specific outlier dummy regressors according to the outliers identified at part 1) and "filtering" it by the linear BV4.1 filter procedure F for trend-cycle and seasonal adjustment. This leads to the model

$$F(O) = F\left(\sum_{i=1}^{h} \mu_i T + \sum_{i=1}^{k} \nu_i S_i\right) + \sum_{i=1}^{l} \alpha_i F(CA_i) + \sum_{i=1}^{m} \beta_i F(U_i^{+}) + \sum_{i=1}^{n} \gamma_i F(EX_i) + \varepsilon^{*},$$

where $\varepsilon^{*} = F(\varepsilon)$ is the new error term. Because it can be assumed that

$$F\left(\sum_{i=1}^{h} \mu_i T + \sum_{i=1}^{k} \nu_i S_i\right) \approx 0,$$

the model used for the estimation of the model parameters $\alpha_i, \beta_i, \gamma_i$ (i.e. of the components CA, U^{+} and EX) is

$$F(O) = \sum_{i=1}^{l} \alpha_i F(CA_i) + \sum_{i=1}^{m} \beta_i F(U_i^{+}) + \sum_{i=1}^{n} \gamma_i F(EX_i) + \varepsilon^{**}.$$

The advantage of this approach is that the need to specify a (global) regression model for the trend-cycle and seasonal components is avoided. The method of estimating the parameters is that of ordinary least squares.

In the last part of the procedure it follows the estimation of the trend-cycle and the seasonal component of series O, based on the time series adjusted for outliers, calendar effects and the effects of the user-defined variables $O^{*} = O - CA - U^{+} - EX$ ($= T + S + R^{*}$). This is done using fixed linear filters (fixed filter approach) where the filters for each observation period $\tilde{t} \in [t_1, ..., t_N]$ are derived from different component-specific moving local regression models, where locally the trend-cycle and the seasonal component are approximated by polynomials and trigonometric functions:

$$O_t^{*} = \sum_{j=0}^{p} \varsigma_j t^j + \sum_{j=1}^{l} (\tau_j \cos \lambda_j t + \upsilon_j \sin \lambda_j t) + \varepsilon_t, \quad t \in B_{\tilde{t}},$$

where

$B_{\tilde{t}} = [t_{\tilde{t},1}, ..., \tilde{t}, ..., t_{\tilde{t},n}] \subset [t_1, ..., t_N]$, $\lambda_1 = 2\pi / P$, $\lambda_j = \lambda_1 \cdot j$, $l = 2$ for quarterly series, $l = 6$ for monthly series, $P = 4$ for quarterly series and $P = 12$ for monthly series. The model parameters are estimated according to a weighted least-squares criterion:

$$\sum_{t_j \in B_{\tilde{t}}} w_{t_j} (O_{t_j} - \hat{T}_{t_j} - \hat{S}_{t_j})^2 = \text{Minimum}(\varsigma_j, \tau_j, \upsilon_j)$$

where

$\hat{T}_t = \sum_{j=0}^{p} \varsigma_j t^j$, $\hat{S}_t = \sum_{j=1}^{l} (\tau_j \cos \lambda_j t + \upsilon_j \sin \lambda_j t)$, $w_t = 1 - \frac{|t - t^+|}{D+1}$, $t^+ =$ period within $B_{\tilde{t}}$ to which is assigned the largest weight ($w_{t^+} = 1$) and $D =$ the longer of the two distances (expressed in numbers of months or quarters) between t^+ and the first and the last period of $B_{\tilde{t}}$. The differences between the different local model approaches concern the order p of the polynomial $\hat{T}$, the number n of periods within $B_{\tilde{t}}$, the position of period $\tilde{t}$ within $B_{\tilde{t}}$ and the position of t^+ within $B_{\tilde{t}}$.

For some periods $\tilde{t}$ the BV4.1 filters are a weighted mean of the results of up to 3 different local regression models. For periods $\tilde{t}$ in the middle part of a time series the same regression model conditions are used, resulting in the (symmetric) so-called central filters.

Figure 4: Gain functions of the central filter (▬▬) and of three concurrent filters ($\tilde{t} = t_{N-2}$, t_{N-1} and t_N) for the estimation of the trend-cycle component.

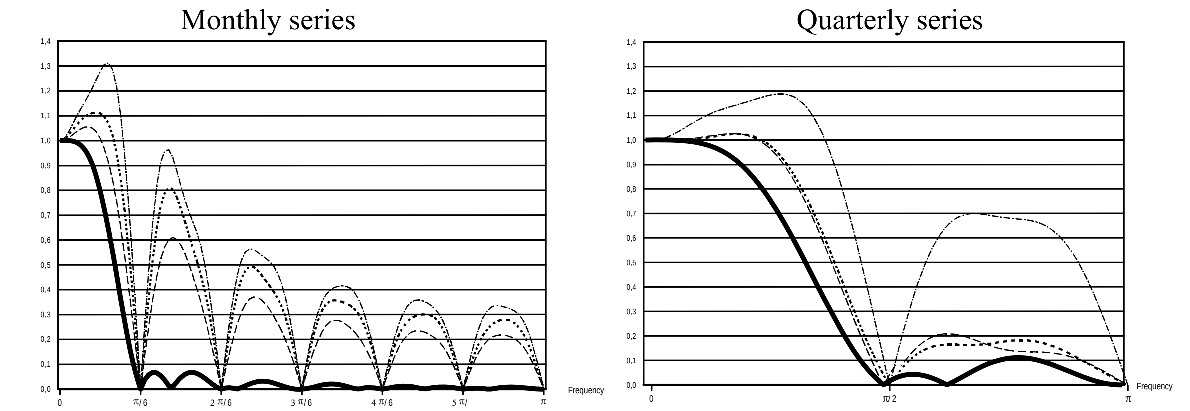
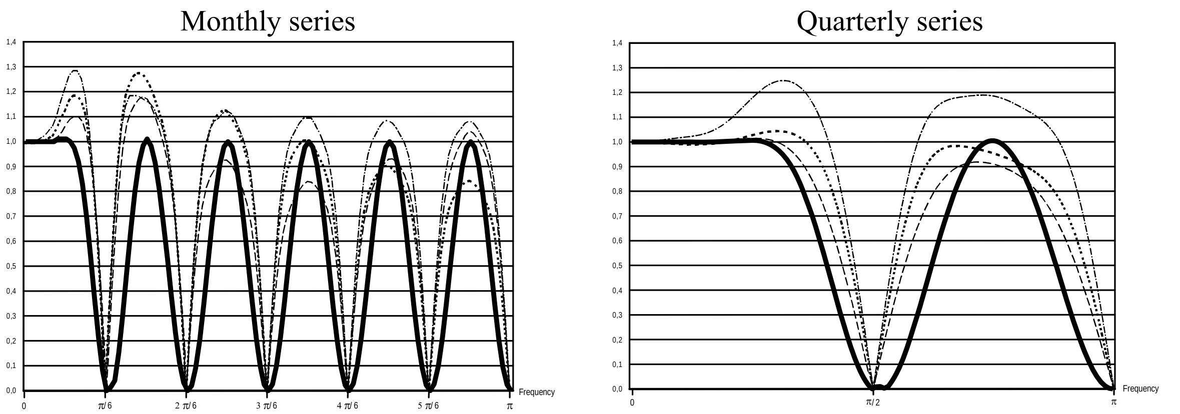


Figure 5: Gain functions of the central filter (▬▬) and of three concurrent filters ($\tilde{t} = t_{N-2}$, t_{N-1} and t_N) for seasonal adjustment.



Calendar Regressors

By default, the following regression model for calendar adjustment is used.

Starting point of the trading day adjustment is a modelling approach for the trading day component considering the differing day-of-the-week compositions of different months or quarters:

$$C_t = \sum_{i=1}^{8} \alpha_i d_t(i),$$

where

$t =$ (individual) period (month or quarter),

$d_t(i) =$ numbers of Mondays ($i = 1$), ..., Saturdays ($i = 6$) in period t which are not public holidays,

number of Sundays ($i = 7$),

number of public holidays, which are not Sundays ($i = 8$),

$\alpha_i =$ regression coefficients ($i = 1,...,8$).

Let $\overline{d_t(i)}$ denote the mean number of "day" i in periods of the same name as t and $\overline{d(i)}$ denote the mean number of "day" i in a period (month or quarter). Then

$$C_t = \underbrace{\sum_{i=1}^{8} \alpha_i \overline{d(i)}}_{C1} + \underbrace{\sum_{i=1}^{8} \alpha_i \left(\overline{d_t(i)} - \overline{d(i)}\right)}_{C2} + \underbrace{\sum_{i=1}^{8} \alpha_i \left(d_t(i) - \overline{d_t(i)}\right)}_{C3}.$$

Because $C1 = const.$, this calendar effect is assigned to the trend-cycle component. $C2$, the length-of-period effect, is assigned to the seasonal component. So with BV4.1 the trading day component is modelled by

$$CA_t = \sum_{i=1}^{l} \alpha_i CA_{ti} = \sum_{i=1}^{8} \alpha_i \left(d_t(i) - \overline{d_t(i)}\right).$$

Level Shifts

Users often know the periods (months or quarters) where level shifts occur in the time series. To improve the analyses it is useful to provide the procedure with this information. In these cases, the first two parts of the BV4.1 procedure as described above, based on the original series, are only used to produce provisional estimates of the level shifts. After that they are repeated, but then the identification of outliers is done based on the provisionally level shift adjusted series.

Regarding output files, the BV4.1 procedure assigns level shifts to the trend-cycle component.

Benefits of the Procedure

- Standardized procedure (i.e. no series specific decisions are necessary, users do not need any special training, expert knowledge and long-term experiences in dealing with the procedure, results are not influenced by the objectives and the qualification of the user, the procedure has a low cost-benefit ratio).
- Efficient modelling of changing seasonal time series structures.
- Trend-cycles are depicted plausibly in terms of economic points of view.
- In principle, due to the linear filters approach components of partial series add up to the corresponding component of the aggregate series (i.e. there is no difference between indirect

and direct analysis of aggregate series). In cases where outliers occur or calendar or user defined regressors are used, this holds true, too, if the user makes sure that for all series involved the regressors are identical.

Shortcomings of the Procedure

- Standardized procedure (i.e. no series specific decisions are possible).

The BV4.1 Software (version 1.1)

Technical requirements:

- Windows NT 4.0 / Windows 98+,
- Java Runtime Environment (JRE) 1.4.1+.

Processing file formats:

- CSV,
- EXCEL 95+,
- ACCESS 97+,
- SQL Server 7.0+.

The software offers:

- BV4.1 analyses of monthly and quarterly time series. Time series with up to 360 observations (data) can be processed. The minimum number of observations is 60 for monthly and 17 for quarterly series.
- BV4.1 analyses with up to 15 user-defined explanatory variables.
- User-friendly graphical user interfaces (GUI).
- Possibility of mass production of time series decompositions and seasonal adjustments.
- Various possibilities of graphic evaluations of the results.
- For each time series analysed, BV4.1 produces output files where detailed information on
    - the analysis,
    - the identified outliers,
    - the regression coefficients,
    - the complete results of the time series decomposition and the seasonal adjustment and
    - selected percentage changes

  is stored.

The DAINTIES Method

Generalities

The DAINTIES method was developed in the late 70's (Fischer (1995); Hendyplan (1997); Hylleberg (1986)) at Eurostat, to replace the SEABIRD method. DAINTIES belongs to the seasonal adjustment procedures based on moving averages derived from local regressions.

DAINTIES allows the user to adjust monthly, quarterly and half-yearly time series. It is based on the basic decomposition model in trend T_t, seasonality S_t and irregular I_t, but only provide the user with the seasonally adjusted series (and, implicitly, the seasonality).

$$X_t = T_t + S_t + I_t \xrightarrow{DAINTIES} \hat{S}_t \text{ et } \hat{X}^{SA} = X_t - \hat{S}_t$$

Moreover, DAINTIES incorporates:

- In the more recent version, an automatic procedure to deal with missing values;
- In the genuine version, an automatic procedure to detect and correct outliers.

These procedures are applied to the time series before the seasonal adjustment.

The Basic Statistical Model

Methods based on moving regressions make the hypothesis the series and/or its components cannot be modeled in a simple way across the complete span. But they admit such a modeling is possible on a quite short span.

General ideas

Thus DAINTIES suppose that, on *m* consecutive observations:

- The trend can be modeled as a third-degree polynomial;
- The seasonality is constant.

Under these hypotheses, the model can be written as:

$$X_t = a_0 + a_1 t + a_2 t^2 + a_3 t^3 + \sum_{i=1}^{p} \alpha_i \mathrm{I}[t \equiv i-1 \text{ mod}(p)] + \varepsilon_t$$

Therefore, the value of the series at date *t* is a function of: the value of the polynomial trend at this same date, the value α_i of the seasonal component at period *i* (month, quarter) corresponding to the date *t* and a residual value. The problem is thus to estimate the parameters of the model: the 4 coefficients defining the polynomial trend and the *p* seasonal factors.

DAINTIES uses for that a classical least squares procedure but the model, as written, is not identifiable and another hypothesis is necessary. This hypothesis is that the seasonal factors sum up to 0 on one year: $\sum_{i=1}^{p} \alpha_i = 0$.

Estimation

On any interval of *m* values $\{X_{T+1}, X_{T+2}, \cdots, X_{T+m}\}$, DAINTIES sets the following model:

$$X = T\begin{bmatrix} a_0 \\ a_1 \\ a_2 \\ a_3 \end{bmatrix} + S\begin{bmatrix} \alpha_1 \\ \alpha_2 \\ \vdots \\ \alpha_{p-1} \end{bmatrix} + \varepsilon = Ta + S\alpha + \varepsilon = [T \mid S]\begin{bmatrix} a \\ \alpha \end{bmatrix} + \varepsilon = Z\begin{bmatrix} a \\ \alpha \end{bmatrix} + \varepsilon$$

- Where T is the (m,4) matrix: $\begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & 2 & 4 & 8 \\ 1 & 3 & 9 & 27 \\ \vdots & \vdots & \vdots & \vdots \\ 1 & m & m^2 & m^3 \end{bmatrix}$
- and S the (m,p-1) matrix whose element s_{ij} is defined as:

$$s_{ij} = \begin{cases} 1 & \text{if } (i-1) \equiv (j-1) \bmod(p) \\ -1 & \text{if } (i-1) \equiv j \bmod(p) \\ 0 & \text{else} \end{cases}$$

The T matrix (respectively the S matrix) is a basis of the vectorial space of third-degree polynomials (respectively of series of period p).

Therefore, we have: $\begin{bmatrix} \hat{a} \\ \hat{\alpha} \end{bmatrix} = (Z'Z)^{-1} Z'X$

And the seasonal component can be directly estimated by $S\hat{\alpha} = Z^* \begin{bmatrix} \hat{a} \\ \hat{\alpha} \end{bmatrix} = Z^*(Z'Z)^{-1} Z'X$, where $Z^* = [0 \quad S]$.

Thus, the value of the seasonally adjusted series is obtained by using the filter W defined by :

$$\hat{X}^{SA} = X - S\hat{\alpha} = X - Z^*(Z'Z)^{-1} Z'X = \left[I - Z^*(Z'Z)^{-1} Z'\right]X = WX$$

Therefore, the W filter does not depend on the values X but only on number m of points in the considered interval. It can be computed independently of the analysed series which simplifies a lot the process.

1. For the m first dates, the values of the adjusted series are derived from the previous formula, using the $\{X_1, X_2, \cdots, X_m\}$ m-uple:

$$\{X_1, X_2, \cdots, X_m\} \to WX \to \{\hat{X}_1^{SA}, \hat{X}_2^{SA}, \cdots, \hat{X}_m^{SA}\}$$

2. For the other points, DAINTIES only retains the value corresponding to the « final » date in the interval:

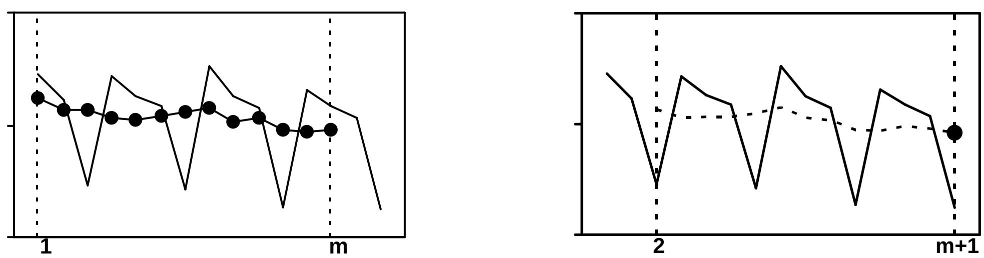
$$\{X_{T+1}, X_{T+2}, \cdots, X_{T+m}\} \to \hat{X}_{T+m}^{SA} = \sum_{i=1}^{m} w_{i,m} X_{T+i}$$

The end-points of the seasonally adjusted series are therefore computed as asymmetric moving averages of past values of the raw series.

The following figure presents an example summarizing the process.

Figure 6: DAINTIES estimation procedure

First *m* points (a)	**Current point (b)**



Explanation:

The straight line represents the raw data. The dots correspond to the seasonally adjusted values.

(a) For the first m points, DAINTIES model (polynomial of degree 3 and strictly periodical seasonality) is fitted. On the interval (m points), the seasonally adjusted values correspond to the estimation of the model without seasonality.

(b) For the current point, the model is estimated on the last m points. The value of the model without seasonality corresponds to the current seasonally adjusted value.

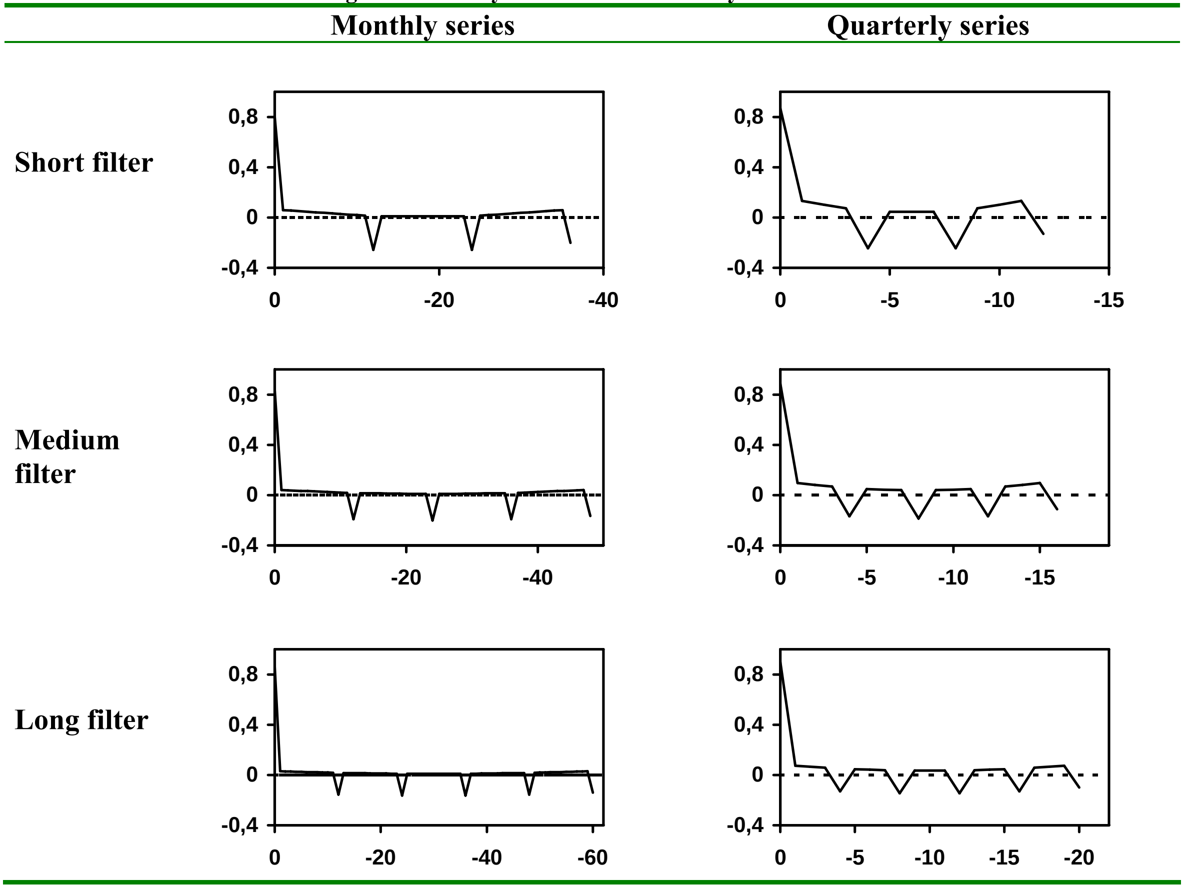
<u>The various filters used in DAINTIES</u>

DAINTIES uses 3 filters :

- A short filter on $3p+1$ points; i.e. 7, 13 or 37 points according to the periodicity of the series.
- A medium filter on $4p+1$ points; i.e. 9, 17 or 49 points according to the periodicity of the series.
- A long filter on $5p+1$ points; i.e. 11, 21 or 61 points according to the periodicity of the series.

The next figure presents the coefficients of these 3 filters for monthly and quarterly series.

Figure 7: The asymmetric filters used by DAINTIES



The Seasonal Adjustment Method

In the most general case, series with more than five years of strictly positive values, the seasonal adjustment is a 3-step procedure:

1. Smoothing of the series with the 3 filters. The implicit decomposition model is the additive one. We get 3 different estimations A_1, A_2 and A_3.

2. Smoothing of the logarithm of the series using the 3 filters. The seasonally adjusted series are derived taking the exponential of the smoothed values. The implicit decomposition model is the multiplicative one and wee get 3 other estimations M_1, M_2 and M_3.
3. Reconciliation of the 6 estimations by re-weighting.

According to the nature of the series (negative or null values for example) or its length, the 6 previous estimates are not always pertinent. DAINTIES adapts its strategy. For example, if the series has less than $4p+1$ points and has negative values, only the short filter is pertinent and we will get only one estimation of the seasonally adjusted series.

The following table summarizes the various possibilities.

Table 1: Number of estimations of the SA series according to the length and the type of series.

Series length	Values	
	Presence of ≤ 0 values	Only positive values
$nobs < 3p+1$	No estimation	No estimation
$3p+1 \leq nobs < 4p+1$	A_1	A_1 and M_1
$4p+1 \leq nobs < 5p+1$	A_1 and A_2	A_1, A_2, M_1 and M_2
$5p+1 \leq nobs$	A_1, A_2 and A_3	A_1, A_2, A_3, M_1, M_2 and M_3

Reconciliation of the Various Estimations

In the next step, the final estimation of the seasonally adjusted series is as a weighted average of the K ($K \leq 6$) estimations obtained for the additive and multiplicative decomposition models.

$$X_t^{SA} = \frac{\sum_{k=1}^{K} P_{t,k} * SA_{t,k}}{\sum_{k=1}^{K} P_{t,k}}$$

The weights are computed, for each date, from the following algorithm:

- For a date t, we consider the p observations[22] at dates $\{t\text{-}p+1,\ t\text{-}p+2,\ \ldots.,\ t\text{-}1,\ t\}$ of one of the K seasonally adjusted series, noted SA_k.
- A straight line is adjusted on these p points and $E_{t,k}$ designs the variance of the residuals[23] computed at date t for the series SA_k. This variance cannot be computed for the first p-1 points for which we use $E_{p,k}$, the value computed for date p.
- For a date t, $\overline{E}_t^{add}$ is the mean of the – at most 3 - variances computed for the SA series corresponding to an additive model.
- If the series SA_k is associated to a **multiplicative model**, and if $E_{t,k} > 0.8\overline{E}_t^{add}$, then $P_{t,k} = 0$.
- In the other cases, $P_{t,k} = 1/E_{p,k}$
- If, then $P_{t,k} = 1$ and the other weights are set to 0.

[22] For monthly or quarterly series, we use 12 or 4 points. For half-yearly series, we use 4 points (2p).
[23] Or, which is equivalent in this procedure, the sum of the square residuals.

Missing Values

The current version of DAINTIES (the one used by DG ECFIN) has a very basic procedure to deal with missing values.

The imputation is only valid for monthly time series and is quite simple.

- On any 12-month span, we cannot have more than *nmiss* missing values (*nmiss* = 0, 1, 2 or 3).
- In that case, a missing value is replaced by the last available value.
- A missing value at the beginning of the series is replaced by the first available observation.

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ANNEX V.

Eurostat Initiatives on Seasonal Adjustment

Eurostat Initiatives on Seasonal Adjustment

In this annex the recommendations concerning seasonal adjustment are presented on the basis of several Eurostat proposals.

The quality of seasonal adjustment depends not only on the quality of the theoretical method but on the external information as well which is mostly available within the National Statistical Institutes only. However the choice of different options depends on the purposes for which the seasonal adjustment is carried out and on what the seasonally adjusted series is intended to measure.

In this situation it is necessary for international organisations (e.g. Eurostat, ECB, etc.) to define some recommendations in order to improve geographical comparability of seasonal adjusted figures between countries and to ensure higher quality of aggregates. The harmonisation and the comparability refer to the seasonal adjusted data and to the seasonal adjustment methods as well.

The Eurostat recommendations concerning seasonal adjustment policy (Eurostat (2000)) give the most overall proposal concerning the choice and change of seasonal adjustment method, transparency of procedures, seasonally adjusted data from member states, consistency in aggregation or in time, publication of seasonally adjusted or trend data, revisions, methodical application of seasonal adjustment programs, working/trading day corrections, treatment of uncertainty and publication of confidence intervals. The first version was published in 1996, the latter in 2000. In this document Eurostat suggests a set of criteria to be used in carrying out seasonal adjustment. Some of these recommendations derive from practical experience, some from theoretical results and others from consideration of users' needs. This proposal was applied first inside Eurostat, later in the NSIs.

Eurostat and the ECB jointly worked up special recommendations for the seasonal adjustment of Quarterly National Accounts (QNA) in accordance with the above mentioned Eurostat policy. The recommendations were published in the Final Report of the Task Force in 2002. (Eurostat-ECB (2002)) The aim of the Task Force was to improve the comparability between the adjusted QNA of EU Member States, moreover, the adjusted QNA of Member States and European aggregates compiled by Eurostat. The recommendations also refer to the adjustment of euro area and EU aggregates.

Later on Eurostat worked out a set of proposal to the Short Term Statistics (Eurostat (2005)) and the Labour Cost Index (Eurostat (2003a), (2003b)). These recommendations are more detailed than the general recommendations (for example they also regulate how the adjusted data should be transmitted to Eurostat).

In 2006 Eurostat has started to develop new internal guidelines on seasonal adjustment in the frame of an internal task force. The main objective of the task force was to analyse the state of the art in SA in different domains and to propose guidelines to increase the convergence of SA practices among Eurostat production units. The task force is also reflecting on the SA tools to be used at Eurostat. The task force has proposed an SA Action Plan, and defined a list of topics within the SA process for which it is important to identify clear guidelines.

Also in 2006 the activity of the Steering Group on seasonal adjustment (SASG) was re-launched to initiatives of Eurostat, the ECB and the Friends of the Chair (FROCH) Group. The first meeting was held in February 2007. One of the main tasks of the SASG is the elaboration of a comprehensive set of guidelines for the ESS. These guidelines should have general validity and be flexible enough to be applied to different domains and to different situations; should refer to a common terminology/glossary (based on "Data and metadata reporting and presentation" by OECD) in order to improve communication; should distinguish between important and less important series and their implementation should be feasible within the tools currently in use. General guidelines might be complemented by more technical ones.

The other tasks of the SASG are to propose a common structure for the exchange of meta-information to describe the seasonal adjustment methodology used for specific series; to foster the exchange of practices in the ESS and improve and promote the use of the existing CIRCA interest group on SA; to promote training activities and exchange information about training opportunities; to study the possibility of developing a coordinated activity for testing and analysing existing and newly developed SA tools.

In 2006 a new task force on seasonal adjustment of quarterly national accounts has been launched by the CMFB in order to deal with SA problems raised mainly by the adoption of the chain-linking method for the volume series. This task force, co-chaired by the ECB and Eurostat, will work in cooperation with the SASG in order to ensure consistency between general guidelines and specific recommendations for national accounts.

Further Eurostat projects whose results are expected in 2007 concern:

- The definition of common seasonal adjustment guidelines for PEEIs. These guidelines are aimed at improving the quality of PEEIs and are focusing mostly on the methodology.

- The seasonal adjustment of external trade statistics. This project is aimed to compare alternative SA options and to identify best practices first for the external trade data and later for some macro-economic statistics.

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ANNEX VI.

Quality Measures for Seasonal Adjustment

Quality Measures for Seasonal Adjustment

In this annex the proposed key quality indicators are presented according to the six quality components. The following indicators can be regarded as a framework, they elements are not fixed, and new indicators can be added.

Relevance

User satisfaction index

The user satisfaction index usually based on the user satisfaction surveys. By use of Quality Satisfaction Performance (QSP) models it is possible to put numerical values on the satisfaction, and to calculate the relative importance of different quality factors. The users can be asked to grade services and products along a number of different quality items on a scale from 1-10. It is then possible to measure what quality aspects are of the most importance for them.

In order to develop this indicator the following preparatory steps are suggested: classification of the users for all surveys in a small number; ranking of the classes of users according to their importance; systematic documentation of the methods currently used for the measurement of user satisfaction for those types of users.

Accuracy

Original data visual check

Graphed data can be used in a visual check for the presence of seasonality, decomposition type model (multiplicative or additive), extreme values, trend breaks and seasonal breaks.

Comparison of the original and seasonally adjusted data by graph

By graphically comparing the original and seasonally adjusted series, it can be seen whether the quality of the seasonal adjustment is affected by any extreme values, trend breaks or seasonal breaks and whether there is any residual seasonality in the seasonally adjusted series.

Length of series

The length of series shows the number of observations (quarters, months) available at different quarters or months. From this data could be count ratio between the number of available data and the expected number of data. Some problem caused by the length of series could be:

- the critical value for outliers depend on the length of the time series;
- if the time series is too short, the revision of seasonal adjusted data could be bigger than in case of a longer series and;
- if the series is too long, the seasonality of the series could change, and the effect on the earlier data are low.

Analysis of Variance (ANOVA)

The ANalysis Of VAriance (ANOVA) compares the variation in the trend component with the variation in the seasonally adjusted series. The variation of the seasonally adjusted series consists of variations of the trend and the irregular components. ANOVA indicates how much of the change of the seasonally adjusted series is attributable to changes in primarily the trend component. The statistic can take values between 0 and 1 and it can be interpreted as a percentage.

The formula to calculate the ANOVA statistic is as follows:

$$ANOVA = \frac{\sum_{t=2}^{n}(DTC_t - DTC_{t-1})^2}{\sum_{t=2}^{n}(DSA_t - DSA_{t-1})^2}$$

Where: DTC_t = trend data for time t; DSA_t = seasonally adjusted data for time t;

This indicator can also be used to measure the quality of the estimated trend.

Stability of Trend and Adjusted Series Rating (STAR)

The STAR indicates the average absolute percentage change of the irregular component of the series. The STAR statistic is applicable to multiplicative decompositions only. The expected revision of the most recent estimate when a new data point is added is approximately half the value of the STAR value

The formula to calculate the Stability of Trend and Adjusted Series Rating (STAR) is as follows:

$$STAR = \frac{1}{N-1}\sum_{t=2}^{N}\left|\frac{(DIR_t - DIR_{t-1})}{DIR_{t-1}}\right|$$

Where DIR_t = data of irregular component for time t, and N = number of observations.

Number of model revision during a year

How many times were revised the model during a previous year. The "rate of model revision during a year" could be calculated in the following way:

(Number of model revisions) / (frequency of time series)

Number of parameter revision during a year

How many times were revised the parameter during a previous year. The "rate of parameter revision during a year" could be calculated in the following way:

(Number of parameter revisions) / (frequency of time series)

Absolute size of revision

The indicator measures the difference between the earlier and the revised seasonally adjusted data.

Let us indicate with x_t^r the value of the time series x at time t (t = 1, 2, … , T) for version r (r = 1, 2, … , s).

In the former case the following absolute errors can be defined:

$E_t(m) = x_t^m - x_t^K$ where m = 1, 2, … , K–1 are the versions.

Based on these absolute errors the following statistics can be computed:

Mean error: $ME = \frac{1}{n}\sum_t E_t(m)$

Mean absolute error: $MAE = \frac{1}{n}\sum_t |E_t(m)|$

Root mean squared error: $RMSE = \sqrt{\frac{1}{n}\sum_t E_t^2(m)}$

where the subscript t takes all the n values for which both x_t^m and x_t^K are available.

Relative size of revision

This indicator based on the absolute size of revision. In the former case the relative error is:

$$e_t(m) = \frac{x_t^m - x_t^K}{x_t^K}$$ where m = 1, 2, … , K–1 are the versions.

Based on these relative errors the following statistics can be computed:

Mean percentage error: $MPE = \frac{1}{n}\sum_t e_t(m)$

Mean absolute percentage error: $MAPE = \frac{1}{n}\sum_t |e_t(m)|$

Root mean percentage squared error: $RMPSE = \sqrt{\frac{1}{n}\sum_t e_t^2(m)}$

where the subscript t takes all the n values for which both x_t^m and x_t^K are available.

Tests on residuals

There are a several tests on residuals, for example normality test, test on skewness, kurtosis, Ljung-Box and Box-Pierce statistics on residuals and squared residuals.

Normality test, test on skewness and kurtosis: The assumption of normality is used to calculate the confidence intervals from the standard errors. Consequently, if this assumption is rejected the estimated confidence intervals will be distorted even if the standard forecast errors are reliable. A significant value of one of these statistics indicates that the standardised residuals do not follow a standard normal distribution; hence the reported confidence intervals might not represent the actual ones. (X12-ARIMA tests for significance at one percent level)

P-values: The p-values show how good the fitted model is. They measure the probability of the ACF occurring under the hypothesis that the model has accounted for all serial correlation in the series up to the lag. P-values greater than 0.05, up to lag 12 for quarterly data and lag 24 for monthly data, indicate that there is no significant residual autocorrelation and that, therefore, the model is adequate for forecasting.

M statistics

X-11, X11-ARIMA and X12-ARIMA provides the diagnostic tables, as well as the M1-M11 quality control statistics. Most of them are obtained from the summary measures of Table F2 of the printout of X11-ARIMA. All the measures below are in the range from 0 to 3 with an acceptance region 0 to1.

M1 The relative contribution of the irregular over three month span. (from Table F 2.B) Statistic M1 is defined, with the Table F2B notations, by:

$$M1 = 10 \cdot \frac{\overline{I}_3^2 / \overline{O}'^2_3}{1 - \overline{P}_3^2 / \overline{O}'^2_3}$$

This contribution is considered acceptable if it does not exceed 10%.

M2 The relative contribution of the irregular component to the stationary portion of the variance. (from Table F 2.F)

$$M2 = 10 \cdot \frac{Contr(I)}{1 - Contr(P)}$$

It is considered again, if it does not exceed 10%.

M3 The amount of month to month change in the irregular component as compared to the amount of month to month change in the trend-cycle. (from Table F 2.H) For monthly series: $M3 = \left|\widetilde{I} / \widetilde{C} - 1\right| / 2$ and for quarterly series:

$$M3 = \left|\widetilde{I} / \widetilde{C} - \frac{1}{3}\right| / \frac{2}{3}$$

M4 The amount of autocorrelation in the irregular as described by the average duration of run (ADR). (from Table F 2.D)

$$M4 = \frac{\left|\frac{N-1}{ADR} - \frac{2(N-1)}{3}\right|}{2{,}577 \cdot \sqrt{\frac{16N-29}{90}}}$$

M5 The number of month it takes the change in the trend – cycle to surpass the amount of change in the irregular. (from Table F 2.E)

$$M5 = \frac{\left|MCD' - 0.5\right|}{5}$$ for monthly series and

$$M5 = \frac{\left|QCD' - 0.17\right|}{1.67}$$ for quarterly series,

where for example

$$MCD' = (k-1) + \left(\frac{\widetilde{I}_{k-1}}{\widetilde{C}_{k-1}} - 1\right) / \left(\frac{\widetilde{I}_{k-1}}{\widetilde{C}_{k-1}} - \frac{\widetilde{I}_{k}}{\widetilde{C}_{k}}\right)$$

M6 The amount of year to year change in the irregular as compared to the amount of year to year change in the seasonal. (from Table F 2.H)

$$M6 = \frac{1}{2.5} \cdot \left|\frac{\bar{I}}{\bar{S}} - 4\right|$$

M7 The amount of moving seasonality present relative to the amount of stable seasonality. (from Table F 2.I)

$$M7 = \sqrt{\frac{1}{2}\left(\frac{7}{F_S} + \frac{3F_M}{F_S}\right)},$$

where F_S is the relative contribution of stable and F_M the moving seasonality.

M8[24] The size of the fluctuations in the seasonal component throughout the whole series.

$$M8 = 100 \cdot \left|\Delta\bar{S}'\right| \cdot \frac{1}{10}$$, where

$$\left|\Delta\bar{S}'\right| = \frac{1}{J(N-1)} \sum_{j=1}^{J} \sum_{I=2}^{N} \left|S'_{Ji+j} - S'_{J(i-1)+j}\right|.$$

M9 The average linear movement in the seasonal component throughout the whole series.

$$M9 = 100 \cdot \frac{\sum_{j=1}^{J} \left|S'_{J(N-1)+j} - S'_{j}\right|}{J \cdot (N-1)} \cdot \frac{1}{10}$$

M10 The size of the seasonal component fluctuations in the recent year.

---

[24] These last four statistics are calculated on the bases of normalized seasonal factors: $S'_t = \frac{S_t - \bar{S}}{\sigma(S)}$

$$M10 = 100 \cdot \left| \Delta \bar{S}' \right|_R \cdot \frac{1}{10}, \text{ where}$$

$$\left| \Delta \bar{S}' \right|_R = \frac{1}{3J} \sum_{j=1}^{J} \sum_{i=N-4}^{N-2} \left| S'_{Ji+j} - S'_{J(i-1)+j} \right|$$

M11 The average linear movement in the seasonal component in recent years.

$$M11 = 100 \cdot \frac{\sum_{j=1}^{J} \left| S'_{J(N-2)+j} - S'_{J(N-5)+j} \right|}{3J} \cdot \frac{1}{10}$$

Q statistics

Since every above mentioned single M statistics for itself is normally not useful to determine if the seasonal adjustment is successful, a weighted average of M1-M11 was created, denoted Q, to give one quality indicator. The weights (under the statistics) show the importance of the M statistics assigned by the developers.

$$Q = \frac{10 \cdot M1 + 11 \cdot M2 + 10 \cdot M3 + 8 \cdot M4 + 11 \cdot M5 + 10 \cdot M6}{100} + \frac{18 \cdot M7 + 7 \cdot M8 + 7 \cdot M9 + 4 \cdot M10 + 4 \cdot M11}{100}$$

Significant regressors with coefficients and t-values

The quality of the SA data depends on the significance of regressors. In case of all regressors (e.g. regressors of calendar effect, outliers) the coefficients and the t-values could be analysed.

Information Criteria

Akaike Information Criteria (AIC) is a measure of the goodness of fit of an estimated model, calculating these criteria could be compared different ARIMA models using the same time series.

In the general case, the AIC is:

$$AIC = 2k - 2\ln(L)$$

where k is the number of parameters, and L is the likelihood function.

The AIC has a tendency to overestimate the parameter p.

Bayesian Information Criteria (BIC)

The BIC is another criterion that attempts to correct the overfitting tendency of the AIC. The BIC is intended to provide a measure of the weight of evidence favouring one model over another.

The formula for the BIC is:

$$BIC = \left(\frac{-2\ln(L) + k\ln(n)}{n} \right)$$

where n is the number of observations, k is the number of parameters to be estimated, and L is the maximised value of the likelihood function for the estimated model.

Forecast error

The percentage forecast standard error is required for each forecast produced and can be found in the forecast table. There will be one number for each period that has been forecasted. The percentage forecast standard error is given by: forecast standard error/forecast

The percentage forecast standard error is applicable to multiplicative decompositions only.

Timeliness and Punctuality

Punctuality of time schedule of effective publication

Average delay in days over published time schedule computed over the last year. The punctuality of time schedule of effective publication is given by:

(Actual date of the effective publication) – (Scheduled date of the effective publication)

Accessibility and Clarity

Number of database accesses

Number of accesses/downloads to the database for the reference period.

Number of accompanying information

The indicator provides information to how many metainformation are available for the users.

Comparability

Number of changes in methods relative to the series' length

This measure indicates, how many times changed the seasonal adjustment method from the first period relative to the all number of observations. This indicator given by: number of changes in method divided by the number of observations in time series.

Number of main divergences between the national and European concepts

This indicator shows how many and in which case are differences between the national and European seasonal adjustment concepts.

Graph of Seasonal-Irregular (SI) ratios

It is possible to identify a seasonal break by a visual inspection of the seasonal irregular graph (graph of the SI ratios). Any change in the seasonal pattern indicates the presence of a seasonal break.

Permanent prior adjustments should be estimated to correct for this break. If no action is taken to correct for this break, some of the seasonal variation will remain in the irregular component resulting in residual seasonality in the seasonally adjusted series. The result would be a higher level of volatility in the seasonally adjusted series and a greater likelihood of revisions.

Months (or Quarters) for Cyclical Dominance

This statistic measures the number of periods (months or quarters) that need to be spanned for the average absolute percentage change in the trend component of the series to be greater than the average absolute percentage change in the irregular component. The months for cyclical dominance (MCD) or quarters for cyclical dominance (QCD) are measures of volatility of a monthly or quarterly series respectively. The formula to derive the statistic is as follows:

MCD (or QCD) = d for which $\frac{I_d}{C_d} \langle 1$ where I_d is the final irregular component at lag d and C_d is the final trend component at lag d

The MCD (or QCD) can be used to decide the best measure of short-term change in the seasonally adjusted series. For monthly data the MCD takes values between 1 and 12, for quarterly data the QCD takes values between 1 and 4. The MCD (or QCD) value is automatically calculated by X12-ARIMA and is reported in table F2E of the analytical output.

Contingency Table Q

The Contingency Table Q (CTQ) shows how frequently the gradient of the trend and the seasonally adjusted series over a one period span have the same sign. The formula to analyse the Contingency Table Q (also called CTQ in the example below) is as follows:

$$CTQ = \frac{U_{11} + U_{22}}{U_{11} + U_{12} + U_{21} + U_{22}}$$

U_{kl} = value for contingency table cell with row *k* and column *l,* where

	ΔC > 0	ΔC <= 0
ΔSA > 0	U11	U12
ΔSA <= 0	U21	U22

where ΔSA is the change in the SA data, and ΔC is the change in the trend.

CTQ can take values between 0 and 1. A CTQ value of 1 indicates that historically the trend component has always moved in the same direction as the seasonally adjusted series. A CTQ value of 0.5 suggests that the movement in the seasonally adjusted series is likely to be independent from the movement in the trend component, this can indicate that the series has a flat trend or that the series is very volatile. A CTQ value between zero and 0.5 is unlikely but would indicate that there is a problem with the seasonal adjustment.

Coherence

UAPE (unbiased absolute percentage of error) between the provisional and final seasonal adjusted data

The unbiased absolute percentage error (UAPE) is an absolute value of the difference between the provisional and final statistics divided by the average of the provisional and final statistics.

Comparison of annual totals before and after seasonal adjustment

This is a measure of the quality of the seasonal adjustment and of the distortion to the seasonally adjusted series brought about by constraining the seasonally adjusted annual totals to the annual totals of the original series. It is particularly useful to judge if it is appropriate for the seasonally adjusted series to be constrained to the annual totals of the original series. The formula for multiplicative models is as follows:

$$\frac{1}{n}\sum_{i=1}^{n}\left|\left(E4_{total(t)}^{D11} - 100\right)\right|$$

$E4_{total(t)}^{D11}$ = unmodified ratio of annual totals for time *t* in the output table that calculates the ratios of the annual totals of the original series to the annual totals of the seasonally adjusted series for all the n years in the series.

The formula for additive models is:

$$\frac{1}{n}\sum_{i=1}^{n}\left|\frac{E4_t^{D11}}{D11_{total(t)}}\right|$$

$E4_t^{D11}$ = unmodified difference of annual totals for time *t* in the output table that calculates the difference between original annual total and seasonally adjusted annual totals for all the n years in the series.

Take in account time consistency

When the seasonal adjustment is applied to the sub-annual monthly or quarterly figures, it is often desirable, from the user point of view, that the sum or average of the seasonal adjusted figures corresponds to the sum or average of the unadjusted sub-annual figures. It could therefore be justified to impose annual time consistency on the sub-annual seasonal adjustment series in the short-term, over the longer term provided that attempts should be made to educate users to accept time inconsistencies. As the purpose of the seasonal adjustment is to distribute the effects of seasonality within the year, the sum of the seasonal components during the year must be equal to zero. Imposing time consistency has no scientific justification but lowers the quality of results.

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ANNEX VII.

Proposal for Quality Report

Quality Report
for
Seasonal Adjustment
in the
Hungarian Central Statistical Office

"General Report"

This quality report is a proposal of Hungarian Central Statistical Office to describe the quality of seasonal adjustment process and its data.

1. Administrative Information

Table 1.1

Name of the statistical product	
Department	
Unit	
Year	
Periodicity of the report	
Date of the filling	
Person(s) who has (have) filled the present report	

2. General Information about the Time Series

Table 1.2

Name of the Time Series	
First observation	
Periodicity of the source data	
Type of data	
Base year	
Source of the data	
Transformation type	
Transformation rule	
Method used to SA	
Software used to SA	
Direct/Indirect adjustment	
Concurrent/Projected adjustment	
Type of outliers to consider	
Type of calendar effect to consider	

3. Missing observation(s)

Table 1.3

Date	Explanation

2. Relevance

Classification and description of SA data users — **Table 2.1**

User	Classification of user	Description of user
1		
2		
3		
4		
5		

Users' needs origin — **Table 2.2**

User	Needs in term of theoretical concepts	Source	Reference document
1			
2			
3			
4			
5			

Users needs satisfaction — **Table 2.3**

User	Measurement of user satisfaction? (Y/N)	State to what extend these needs have been fulfilled in the users' eyes	Reference document on user satisfaction
1			
2			
3			
4			
5			

3. Accuracy

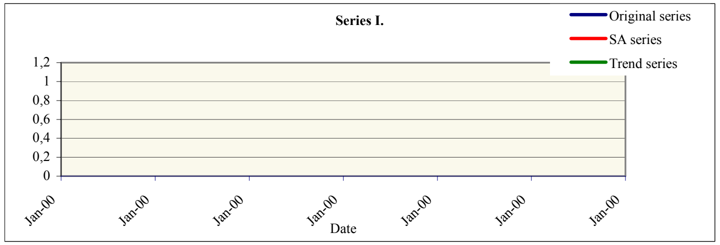
3.1. Data visual check

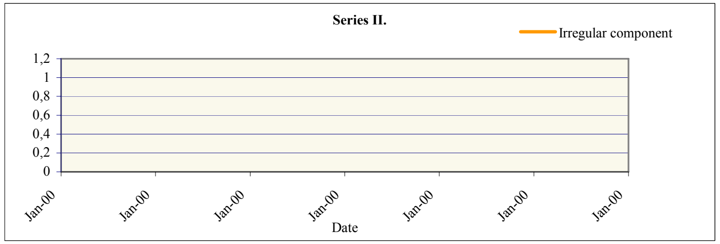
Table 3.1.1

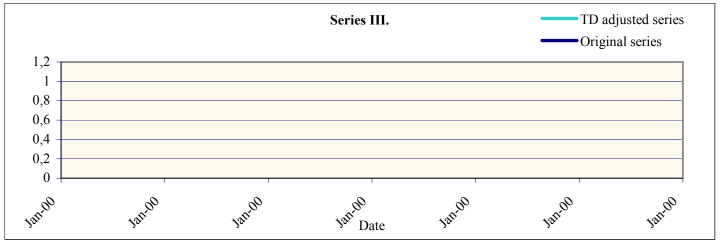
Series	Mean	St. Deviation
Raw		
SA		
Irregular		

Table 3.1.2

Date	Original series	SA series	Trend series	Irregular component	Seasonal component	TD adjusted series	Linearised series







3. Accuracy

3.2. Model and Parameters

Table 3.2.1

ARIMA model	(, ,) (, ,)

Table 3.2.2

	Model coefficients	t-value	Prob at 5%
Non - seasonal AR lag( )			
Non - seasonal AR lag( )			
Non - seasonal AR lag( )			
Non - seasonal MA lag( )			
Non - seasonal MA lag( )			
Non - seasonal MA lag( )			
Seasonal AR lag( )			
Seasonal AR lag( )			
Seasonal AR lag( )			
Seasonal MA lag( )			
Seasonal MA lag( )			
Seasonal MA lag( )			

Residual statistics **Table 3.2.3.**

	Value	Prob at 5%
Mean of residual		NA
Standard deviation of res.		NA
Ljung-Box statistics		
Normality test		
Ljung-Box on squared res.		
Box-Pierce statistics		
Box-Pierce on squares res.		

Information Criteria **Table 3.2.4.**

	Value
AIC	
BIC	

3. Accuracy

3.3. Regressors

Table 3.3.1.

Regression type	coefficients	t-value	Prob at 5%
Trading/working day			
Trading/working day with national holidays			
Leap year			

User defined regression **Table 3.3.2**

Regression type	coefficients	t-value	Prob at 5%

3.4. Outliers

Date	Type of Outlier	t-value	Prob at 5%	Explanation	Rule for determination

3.5. Seasonal Adjustment Measures

Table 3.5.1.

Statistic	Value	Statistic	Value
M1		M8	
M2		M9	
M3		M10	
M4		M11	
M5		Q1	
M6		Q2	
M7			

3.6. Size of Revision

Table 3.6.1.

Indicator	**Revision value**
Absolute size of revision	
Reltaive size of revision	

4. Punctuality for monthly/quarterly data

The main dates of the month/quarter **Table 4.1**

	Planned	Realized	Time lag	Reason(s) for late delivery
Date of beginning of the SA process				
Date of end of the quality check				
Date of the first national publication				
Date of other publication				

5. Accessibility and clarity

List of type, frequency and media of publications **Table 5.1**

Type	Frequency	Media

Conditions of access to data **Table 5.2**

List of the information accompanying the data **Table 5.3**

Accompanying information	Media

Further assistance available to users **Table 5.4**

Assistance	Media

6. Comparability

Over time

A.) Changes in concepts and definitions in the original data (this could include changes in coverage; changes in administrative rules and legislation; changes in classifications; changes in geographical boundaries;…)

Table 6.1

Date	Explanation

B.) Changes in methodology of the data production in the original data

Table 6.2

Date	Explanation

C.) Changes of seasonal adjustment method

Table 6.3

Date	Explanation

D.) Other changes in time

Table 6.4

Date	Explanation

Over space

Divergence of the national concepts from European concepts

Table 6.5

in raw data	
in SA	

7. Coherence

Description of difference in concepts between provisional and final statistics

Table 7.1

Comparison between provisional and final statistics with APE and UAPE

Table 7.2

	Provsional statistics	Final statistics	Difference
APE			
UAPE			

Method to ensure time consistency **Table 7.3**
